WEAPONS AND MUSKETRY

SPECIAL TEXT NO. 4

PREPARED
UNDER THE DIRECTION OF THE
COMMANDANT, MARINE CORPS SCHOOLS,
FOR USE WITH THE CORRESPONDENCE
COURSES, MARINE CORPS SCHOOLS

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FORWARD

The weapons of the infantry today are the rifle with its bayonet, the automatic rifle, the hand grenade, the rifle grenade, the automatic pistol, the machine gun, the 37m/m gun, and the 3-inch mortar. The first five are part of the equipment of the rifle company, while the machine guns, the 37m/m gun and the 3-inch mortar are grouped in the battalion machine-gun and howitzer company. It is the primary purpose of this text to describe the tactical characteristics of all of these weapons.

No treatise on infantry weapons is complete that neglects "musketry," a subject which pertains to the use of the weapons of rifle squads and sections. This subject is taken up following the discussion of the weapons of the rifle company. In the training of the individual, musketry follows "marksmanship," the latter being a stage in which he is taught to fire at formal targets at known distances. Musketry is followed in turn by "combat practice," which is a prelude to instruction in tactics. Marksmanship and combat practice will not be treated of in these pages, however, as this text is devoted to weapons. After musketry, therefore, this discussion will turn to the machine gun and then to the 37m/m gun and 3-inch mortar.

The infantry weapons themselves having been first considered, Sections VI and VII discuss briefly their tactical employment in attack and defense; finally, there is presented a brief treatment of some of the weapons of artillery, of their ammunition and its effect, as well as of the employment of these firearms.

This matter is included because infantry and artillery are so closely associated in combat that every infantry officer studying weapons must have at least a rudimentary knowledge of those of the infantry's principal supporting arm—the artillery.

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SECTION I

WEAPONS OF RIFLE COMPANY

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1. General.—For convenience of discussion, the weapons of the rifle company will be described before proceeding to machine guns, 37m/m guns, and the 3-inch mortar. Certain members of the company who do not belong to squads are armed with the automatic pistol; all others, with but a few exceptions, are grouped into squads; therefore to tell what the weapons of a squad are is to describe the arms of practically all men in the rifle company who do not carry automatic pistols.

2. Automatic Pistol.—There are 13 men in each war strength marine rifle company who are armed with the automatic pistol, cal. .45, M1911; these are the five commissioned officers, the first sergeant, three gunnery sergeants (platoon sergeants), the signal corporal, the two field musics, and the signal private. The automatic pistol is a powerful and accurate weapon. It weighs two pounds and seven ounces, and shoots a bullet composed of lead and enclosed in a jacket of cupro-nickel weighing 230 grains. Some impression of the penetrating and striking effect of the bullet can be gained from the fact that it has an initial velocity of 802 feet per second, and an initial energy of 329 pounds; at 100 yards it will penetrate 5½ inches of white pine. The automatic pistol can be fired with rapidity and accuracy; an operator, beginning with the pistol empty but with loaded magazines on a table by hsi side shooting at a range of 25 yards and at a target whose demensions were six by two feet, has been able to fire 21 times in 28 seconds and make a total of 21 hits within an area whose mean radius was 5.85 inches.

Although effective in the hands of an expert, the average trained marine is incapable of firing the pistol with anything like the accuracy that characterizes his employment of the rifle. This is especially true at the longer ranges, and is due to the fact that the pistol is operated from the standing position with one arm extended and unsupported by sling or rests. Too much stress cannot be laid on the fact that the pistol is an emergency weapon. When the time comes to employ it, every man armed with it should be able as a result of his previous training, to bring it into use in the minimun time. For the average marine 25 yards is the maximum range at which he can be counted upon to use it effectively.

3. Rifle Squad.—Those of the rifle company personnel not armed with the pistol carry either the rifle or the automatic rifle. Each of the squads of a company is composed of a corporal and seven men as shown in Figure 1.

The location and duties of the squad in combat are as follows: The corporal commands the squad, and usually during action remains in rear of the firing line in order to control and apply its fire; No. 1 front rank and No. 1 rear rank are scouts; No 2 front rank is the rifle grenadier; No. 2 rear rank is a rifleman; No. 3 front rank is the substitute automatic rifleman; No. 3 rear rank is the automatic rifleman; and No. 4 rear rank is second in command of the squad.

All members of the squad except the automatic rifleman are armed with the rifle and bayonet. The rifle grenadier, in addition to his rifle and bayonet, is equipped with a grenade discharger capable of being attached to the muzzle of his rifle; by means of this V.B. fragmentation rifle grenades may be fired. Smoke and lachrymatory (tear gas) grenades do not require the use of the discharger as they are attached to a

rod inserted into the bore and discharged by means of special ammunition. In addition to these rifle grenades, all members of the squad, when the tactical occasion demands, are armed with hand grenades. The squad does not, on all occasions, carry hand and rifle grenades on going into combat; these are weapons which can only be advantageously employed on certain special occasions, such as mopping up dugouts or repelling attacks from behind shelter. This being the case, rifle and hand greandes are carried on the company trailers for issue to organizations prior to combat or whenever their employment is anticipated.

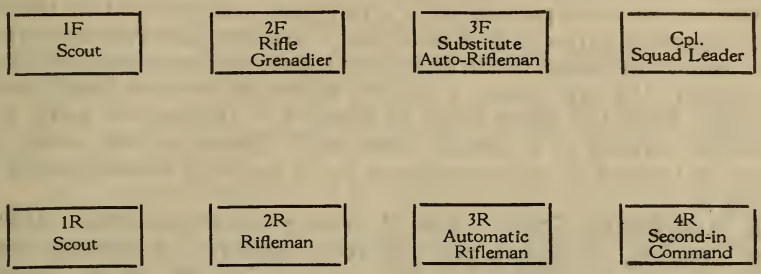

Figure 1—Rifle Squad

4. Rifle and Bayonet.—The United States rifle, cal. .30, M1903, is the only cal. .30 rifle at present authorized for general issue to the service. It is sometimes popularly referred to as the "Springfield rifle," because it was first manufactured and is still made at the Springfield Armory, Springfield, Mass. It is a breech-loading magazine rifle of the bolt type. The magazine of the rifle will hold five cartridges, and one additional cartridge may be inserted in the chamber, thus making the maximum capacity of the rifle, for any one loading, six shots. In order to facilitate the loading of the magazine, cartridges are ordinarily put up in brass clips, holding five cartridges each. The magzaine, however, may be loaded by inserting single cartridges by hand, one after the other. The total weight of the rifle, including oiler and thong case, but without bayonet, is 8.69 pounds. The bayonet weighs one pound.

The rifle is a powerful and accurate weapon, capable of considerable rapidity of fire. Its power is exemplified by the fact that it will shoot a bullet weighing 150 grains at an initial velocity of 2,700 feet per second; its maximum range is 3,450 yards, and at 600 yards its bullet will penetrate 12.46 inches of one-inch oak boards, or 12.3 inches of loose, dry sand. The rifle may be used either as a single loader or for magazine fire. In the latter case as many as 25 aimed shots have been fired in one minute; fired from the hip without aim it has been operated as many as 40 times a minute.

In spite of the addition of numerous auxiliary weapons, the rifle with its bayonet constitutes the main reliance of the infantry soldier in most situations; it is primarily the weapon for frontal and distributed

fire. Developments in the rifle have flattened its trajectory and extended its effective range. The trajectory now is such that if a rifle be fired from the prone position while aimed at the waist line of a man standing 600 yards distant, hits will be obtained on men standing in the line of sighting at any place between the rifle and a point 90 yards beyond the target. At short ranges, trained riflemen can fire 10 well-aimed shots per minute. The maximum effective range of the rifle varies according to the nature of the target; in general, it can be taken to about 1,000 yards.

The bayonet is an essential addition to the rifle. An enemy can not be shot out of entrenchments, but must be driven therefrom by personal contact or the threat thereof. A knowledge of the use of the bayonet lends great moral assistance to the advance to close quarters. However, the mere possession of a bayonet, unsupported by the ability and the desire to use it, is of no value. The first personal encounter of a war usually indicates which opponent is best prepared for close fighting; thereafter, the one better prepared advances more willingly to close combat, while the other seeks to avoid it. The lack of spirit to seek personal combat is a serious handicap. Therefore, the infantryman must be trained to have confidence in his bayonet and to have a desire to use it.

5. Automatic Rifle.—The Browning automatic rifle, M1918, is a self-loading, air-cooled, gas-operated, magazine-fed, shoulder weapon. It has no special cooling system, the barrel being exposed to the air, and the hand of the firer protected on the under side of the barrel by a large wooden forearm. Care must be taken to avoid touching the barrel during firing. The mechanism of the rifle is operated by the power furnished by the powder gases following ignition of the cartridge. These gases expand through a port in the barrel, and act upon the head of a piston, driving it to the rear. Its rearward movement actuates the process of unlocking, of extraction and ejection of the empty cartridge case, and compression of the recoil spring; during its forward movement back into place, caused by the recoil spring being released from compression, the operations of feeding in a new cartridge, locking the bolt, and igniting the cartridge are accomplished. The rifle is fed from a magazine having a capacity of 20 cartridges.

The fire delivered by this weapon is of two different classes; automatic and semi-automatic. The former occurs in bursts of from three to five shots, with one squeeze of the trigger for each burst and without re-aiming between shots. Firing thus, the weapon is capable of discharging 150 rounds per minute. Use of automatic fire, however, is exceptional, since it is inaccurate even at close ranges, hard on the rifle due to excessive heat and vibration, and wasteful of ammunition. Its only advantage is the effect on the morale of both friendly troops and the enemy.

Semi-automatic fire is delivered at the rate of one shot for each squeeze of the trigger, each shot being an aimed shot. It is more accurate, consumes less ammunition, and is easier on the rifle than is automatic fire. A well-trained automatic rifleman can, if necessary, deliver practically the same volume of fire with semi-automatic as with automatic fire. However, a rate of 40 to 60 rounds per minute is considered the best. A total of 110 aimed shots in one minute semi-automatic fire and 160 unaimed shots (assault fire) semi-automatic have been attained with 20 round magazines, but such rates are to be maintained only in emergencies and for a very short time.

The dispersion of the Browning automatic rifle fired semi-automatically (single shots) is practically the same as that of the rifle. When it is fired automatically (in bursts), the vertical dispersion is from two to four times (8 to 10 mils), and the horizontal dispersion is from five to seven times (12 to 15 mils), that of the rifle. The outstanding fire characteristics of the Browning automatic rifle are as follows:

It is capable of rapid production of a large volume of fire.

It is able to deliver fire from any of the positions ordinarily used by the rifleman.

It has practically the mobility, visibility, and vulnerability of one service rifle, together with the fire power of several.

Its cone of fire is deep and narrow when fired semi-automatically.

Its fire is easily controlled and directed.

On account of the lack of a stable mount, it is not suitable for overhead fire or indirect laying.

It is not capable of sustaining fire as long as the machine gun.

It is liable to accidental cessation of fire, due to mechanical derangement.

As it has no bayonet, it can act only by means of fire power.

The fire of the automatic rifle will equal that of several rifles for all ordinary purposes. For fire on special targets, such as at a dense target or in enfllade (to be discussed later), it will be as effective as a much greater number of rifles. Because of this the automatic rifle is the most valuable fire weapon in the squad. It is accordingly necessary to have all men of the squad throughly trained in its use, so that it can be kept in action as long as possible. No emplacements are necessary, and firing positions can be changed as often as necessary. It makes a very indistinct target, hard to locate, and harder yet to hit. If semi-automatic fire is habitually employed, the location of the automatic rifle will not be revealed by the noise of the firing. Because of its mobility, it can accompany the squad at all times. Because of the nature of its cone of fire, flank fire upon a linear target is always desirable. Its fire can be shifted in any direction with a minimum loss of time. It is fired by one man and consequently is much more easily controlled than several rifles in the hands of several men. Because of its unfitness for overhead fire and indirect laying, automatic rifles should not be assigned to such work. Since the automatic rifle is not able to deliver sustained fire, training will insure that its volume of fire is no more than the target presented may require. The men in the squad should be fully trained to reduce stoppages and to keep the gun in action as long as possible. The ammunition for the automatic rifle is the same as for the rifle, and is carried in special containers distributed among the riflemen of the squad. The containers can be refilled with rifle ammunition on the battlefield.

6. Thompson Sub-machine Gun.—While the Thompson sub-machine gun is not an authorized weapon of any infantry unit, it is often used in the Marine Corps as a special weapon in bush warfare, in quelling riots, on mail guard duty, etc., and for this reason should be mentioned in connection with other infantry weapons. It is a self-loading, air-cooled, recoil-operated, magazine-fed, shoulder weapon weighing about ten pounds. The mechanism of the gun is operated by the power furnished by the expansion of the gasses in the chamber upon firing, pushing forward against the bullet and to the rear (when somewhat

lessened), ejecting the empty cartridge case, cocking the piece, and compressing the recoil spring, which in turn in returning forward reloads the piece for the next shot. The fire delivered may be either automatic or semi-automatic. The cyclic rate of automatic fire is 600 rounds per minute. It is recommended to be fired semi-automatically, however. A rate of fire of 100 aimed shots per minute may be obtained in this manner.

The gun fires ordinary .45 cal. pistol ammunition. The box magazine holds 20 rounds, and the drum 50 rounds. The ballistic qualities of the weapon are similar to those of the automatic pistol. The sight is graduated up to 600 yards, but the effective range is less than 350 yards, except when using tracer ammunition when good results may be obtained up to the limit of the sight. The battle sight is set for 50 yards.

Thus it can be seen that this gun is an excellent weapon at very close ranges but its effectiveness rapidly diminishes with the range.

7. Hand Grenade.—The fragmentation hand grenade, Mk. II, weighs about 22 ounces. It has a body made of cast iron, and is about the size and shape of a large lemon. It has a high explosive filler, and its outside is serrated; this latter feature aids the filler, on exploding, to break the body into about 40 fragments. To fire it, the safety pin of the grenade is pulled out and the missile is thrown; its mechanism is such that the grenade explodes from five to seven seconds after the release of the safety lever, which occurs as the weapon leaves the hand.

The effective bursting radius of the fragmentation hand grenade, Mk. II, is 30 yards, although hits may be obtained and serious injuries inflicted up to 200 yards. The arm is most effective when used against an enemy from 30 to 45 yards from the thrower, though exceedingly skilled bombers have obtained accurate results up to 65 or 70 yards. Because of its effective bursting radius, when exploded from 30 to 45 yards from the thrower the hand grenade is effective from ranges varying from zero to 75 yards.

The hand grenade can be thrown from the standing, kneeling and even prone positions; however, because of its possible effect on friend and foe alike, it should only be employed from behind cover of some kind. Hand grenades are effective against personnel only. On the defensive they are best employed thrown at an approaching enemy from behind the cover of trenches; on the offensive they are valuable adjuncts for mopping up dugouts and cellars, and for close fighting in woods.

8. Rifle Grenade.—The V. B. rifle grenade, Mk. I, weighs about 17 ounces. It is made of malleable iron, and is about two and one-half inches long by two inches in diameter. It is cylindrical in shape, with a rounded top and flat base. It is serrated inside; this helps the high explosive with which the gernade is filled to burst the body into a great number of pieces when the weapon explodes. The grenade is also pierced longitudinally with a bullet tube through which the bullet from the rifle cartridge passes when the rifle is fired. The rifle grenade is fired from the V. B. rifle grenade discharger which is a device that can be attached to any service rifle. To use the grenade, the soldier places the discharger on his rifle, inserts the grenade discharger, and fires the rifle, The bullet passes through the grenade. The grenade is then expelled from the discharger by the force of the gasses which follow the bullet and impinge on the flat base of the grenade. The mechanism of the grenade is such that it explodes, bursting into about 25 to 40 pieces, about five to seven seconds after being discharged.

The smoke rifle grenade Mk. 1 weighs about 16 ounces and is made of smooth sheet steel. The complete round consists of four units; the fuze M-9, body, rifle rod, and chemical rifle grenade blank cartridge. The grenade is assembled by screwing into the body the fuze and rod. The grenade is fired by inserting the rod into the bore of the rifle, then pulling safety pin, loading rifle with special cartridge, elevating the muzzle and firing.

The lachrymatory rifle grenade Mk. II weighs 9.8 ounces and is made of smooth sheet steel with two annular corrugations. The grenade is packed, fuzed and fired in the same manner as the smoke grenade. It is to be remembered that special blank cartridges must be used in firing these grenades. Chemical grenades are fuzed for 8.3 seconds.

The rifle grenade has a greater range of effectiveness than the hand grenade, but it is also effective against personnel only. It may be employed by firing directly at the target, or more frequently, by elevating the muzzle of the gun and employing high angle of fire against the hostile dispositions. In employing high angle fire, the rifle is pointed upward, thereby causing the grenade to describe an arc of considerable height and to fall from above on the target in question. In this class of fire, the rifle being elevated from 40° to 80°, the V.B. grenade can be fired at targets ranging from 180 to 120 yards respectively. The grenade's effective bursting radius is 30 yards. Thus when we consider the effective radius of the grenade itself, we see that it may be used against enemy personnel whose distances from the firer vary from 210 yards to 90 yards. The smoke and lachrymatory grenades are fired at angles of from 15° to 45° giving range of from 185 yards to 265 yards. The bursting radius, however, is only about 10 yards. Rifle grenades, on account of their destructive qualities and the effect which they produce on morale, may often be used tellingly against an enemy, particularly when he is taken at a disadvantage.

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MUSKETRY

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9. General.—Today, as in history, rifle fire is the element which most frequently determines the issue of battle. Victory usually can not be attained if this fire is not more effective than that of the enemy. To obtain results in delivery of rifle fire, it is not enough that individuals be accurate shots, for, like everything else in which men are working for a common end, it is teamwork that counts. This teamwork in the application of fire is "musketry"; as a training phase it is taken up after troops have progressed to and completed instruction in marksmanship of the rifle. In its essence, musketry is the application and control of the collective or combined fire of a group of riflemen called a "fire unit." This latter is one which in battle can be under the immediate and effective control of its leader; in our service, the rifle fire units are the rifle squad and, at times, the rifle section.

10. Fire Superiority.—The object of all musketry training is to obtain on the battle field what is called fire" superiority," without which a continued and effective advance is impossible. Fire superiority is obtained by placing such a heavy volume of effective fire on hostile troops as to compel them to seek cover, thereby reducing the volume and effectiveness of their fire. As may be seen, fire superiority is a product not of infantry alone but also of the fire of the auxiliary arms, such as artillery and the air corps. Whatever the arm of the service, fire superiority can be obtained only through the existence of "fire discipline" and "fire control," two essential elements of musketry. Later will be discussed "fire distribution," another important element of musketry ,and finally some characteristics of rifle fire will be presented.

11. Fire Discipline.—Fire discipline is a state of order, coolness and obedience, existing among troops engaged in a fire fight. When fire discipline is good, men fight as they have been trained to fight, and they obey orders promptly and carefully. Each man does his work in an accurate and effective manner. He resists and overcomes the influence of dangers, excitement, and confusion, and does not allow these conditions to interfere with his work.

Without fire discipline, perfection in other training is of no value, for the action of troops in battle will be governed by fear and excitement, and they will put little, if any of their training into effect. Fire discipline is necessary for proper control by leaders, and upon this control depends teamwork and the effectiveness of the collective fire of the unit.

12. How Developed.—Battle is the only real test of fire discipline. In training there are two general considerations; first, the training of the

individual, and second, the methods of maintaining fire discipline in battle. The individual must be so throughly trained that correct action will become a fixed habit instinctively followed in battle. More important than this is the encouragement and development of a soldierly character of great strength. The infantryman must place duty above life, and go into battle with a fixed determination to play the part of a soldier and a man.

The training necessary to insure good fire discipline cannot be given during the brief period of a course in musketry. It must start with the soldier's first drill, and continue throughout his military training. Any drill or exercise which instills the habit of obedience or other soldierly qualities will aid in developing the character essential to fire discipline. When the test of battle comes, the best fire discipline will be found in those organizations whose leaders have the confidence of their men, and who have always insisted on prompt execution of orders, careful attention to the details of training, and the development of soldierly qualities.

13. Execution and Transmission of Orders.—Included in fire discipline is the state of general discipline which insures correct execution and transmission of orders in the heat and excitement of battle. It is essential that all orders and signals must be repeated back to the sender and then promptly obeyed or passed on. Men on the firing line receive orders from the squad leader direct or from one of the men next in line. Orders received from a man next in line are passed on to the man on the other side. When the squad leader desires an order passed, he so directs, and in this case it is sent both to the right and left. Orders intended for a single man only refer to him by name; for example, "Tell Jones to watch the tracers and get on the target."

In the confusion of battle there is danger that one of the enemy disguised in one of our own uniforms will work his way into our lines and give false orders, such as "Cease firing" or "To the rear," which, if obeyed and passed on will result in disaster. To avoid this danger, the name of the leader giving such orders will be stated as the order is passed along. If the source of the order is not stated, the authority for it is verified at once.

14. Verification of Orders.—In very rare cases it may happen that a man, to conceal his own desertion in the face of the enemy, will try to start a general retreat by yelling out false orders. He may even give the supposed source of the order, as "Sergeant Smith says to fall back to the woods". Orders to fall back under fire will be very rare, and all such orders to retreat are open to suspicion. Each man must assure himself that such orders have the approval of his squad and section leaders before he obeys them. This precaution, combined with the alertness and prompt action of leaders, will prevent disaster caused by false orders. The spy or traitor who gives such false orders in combat can expect to be shot.

15. Economy of Ammunition.—The soldier habitually fires at the rate most effective under the exisiting conditions. At times a slower rate may be prescribed by leaders to save ammunition. The ammunition of men who are casualties is used to replace what is expended.

16. Observation of Enemy.—Observation of the enemy is necessary in order to note the effect of fire, take advantage of fleeting targets, and to save ammunition when targets disappear hehind cover. Careful observation is not reserved for scouts and leaders, but is the duty of all

members of the squad. New targets are called to the attention of the squad leader.

17. Use of Cover.—The use of available cover is important for two reasons. The man who neglects the use of cover will be seen and hit. His squad not only loses the fire effect of his weapon, but its position is unnecessarily disclosed, and other casualties may follow. The individual use of cover is taught in scouting and patrolling. In musketry the principles are the same, except that the ability to see and fire on the target is of more importance than the matter of cover. In seeking cover in a firing position, men may move a few yards in any direction, but they must not be allowed to bunch together behind concealment which does not afford protection from fire. Neither should they move out of their relative positions unless so directed by the squad leader. They avoid positions which will mask the fire of others or cause their own fire to be dangerous to other men of their unit.

18. Replacement of Casualties.—In musketry training the replacement of casualties is limited to the replacement of leaders and automatic riflemen, who are caused to fall out during exercises to simulate casualties. The squad must always have a leader, and the automatic rifle should be manned so long as it can be kept in action. Replacement of casualties is the element of fire discipline which keeps the squad or section working as a team in spite of losses. Training in replacement of casualties gives experience in the duties of the next higher grade.

19. Maintenance of Fire Discipline.—Fire discipline is maintained by leaders chiefly by their example of coolness and courage. Any breaches of this discipline are checked by orders, command, signals, or even by physical means when necessary. In the squad, fire discipline is a concern of the squad leader. His position in rear of his unit permits him to observe its members easily. In emergency he may call on any of his men for assistance although ordinarily all of them give their entire attention to the target.

Fire discipline in the section is maintained by the section guide. While responsibility rests with the section leader, it is best that the latter should be free to devote his entire attention to the enemy and to the general control of the fire of his section. It is for this reason that the section guide is expressly charged with the duty of maintaining fire discipline and not with keeping in communication with platoon headquarters. The section guide sees that the squad leaders properly perform their duties, and any breaches of discipline are perferably checked through the squad leader concerned.

20. Initiative.—In an emergency, or when control by the section leader is impracticable, the squad leader of a properly disciplined organization, acts on his own initiative in carrying out what he believes to be the desire of the section leader. Similarly, if any group of individuals find themselves without a leader, it is proper for one of them to assume leadership of the group and carry out its mission or attach it to the nearest organized unit.

An individual separated from his squad fights on his own initiative only when he has reason to believe that his single effort will accomplish some important result. Otherwise he reports to the nearest leader at once.

21. Fire Control.—Fire control, another important element of musketry, is the personal regulation of rifle fire by the leaders. Squad and section leaders are especially concerned with this, and they thereby

bring the fire of the rifles and automatic rifles of their units to bear on a designated target, using the proper class of fire. With good fire control, leaders can cause all or a desired portion of their men to cease firing promptly or to engage a new target. The rates of fire can also be increased or decreased.

Fire control is essential to teamwork and to the effectiveness of collective fire. Without it troops can not be intelligently handled in battle. They will not know when the leader desires them to fire, upon what he wants them to fire, or when he wants them to cease firing. Uncontrolled fire is often worse than useless. It wastes ammunition and discloses the position of troops to the enemy, with no corresponding advantage.

22. Formations.—Before entering the fire fight the section is deployed. In a general way, this deployed formation is retained while the section is delivering fire. The right squad remains the right squad, and the left squad remains the left squad of the section. Within the squad, men normally retain their original order from left to right, although the squad leader may direct the automatic rifleman to move to a flank of the squad or to take a better firing position. Conforming to the original formation to this extent avoids confusion and makes control easier.

The skirmish line of extended order drill may be fairly straight and regular, the intervals between men being approximately equal. This, however, will seldom be the case when the section or squad is firing in battle, because a formation in line is easily seen and hit by the enemy, and usually fails to take full advantage of available natural cover.

The section leader generally occupies a certain area with his section in such manner that the squads composing it will not be on line with each other. There is no attempt to make the intervals between squads uniform. Similarly within the squad the men avoid forming a line, and the intervals between them are not generally uniform.

The chief considerations governing the placing of squads in the section area and of individuals in the squad area are as follows:

a. Good field of fire to the front.

b. Proper use of cover.

c. An indefinite and inconspicuous formation which will be hard to see and hit.

d. Ability of squad and section leaders to control the fire of their units.

e. Character and directions of fire which may be expected from the enemy.

When these requirements conflict, it is the duty of leaders to weigh the importance of each and make the best dispositions possible under the conditions.

In all exercises in fire control the positions of squads and men will be selected in accordance with the provisions set forth above.

23. Exercise of Fire Control.—Squad and section leaders exercise fire control by means of orders, commands, and signals. The effectiveness of the section leaders' control will depend largely on the alertness of the squad leaders in glancing frequently toward him for signals. At times when there is considerable noise and signals are to be expected, the squad leaders glance toward the section leader about once every 10 or 15 seconds. This takes only two or three seconds, but it may save the section leader from the nesessity of crawling over to a squad leader or of hitting him with a pebble to attract his attention.

Fire control is retained by the section leader as long as he is able to do so. The coördinated fire of two squads acting under the control of the section leader is more effective than the fire of the same two squads acting independently.

At times, however, on account of heavy enemy fire, particularly in semi-darkness or smoke, it will be impossible for the section leader to control the fire of his entire unit. This loss of contol is to be recognized as a natural result of such conditions, and will have no serious effects if the squad leaders are quick to take the initiative and carry on the plans of the section leader with their squads acting individually. Fire control by the section leader is re-established as soon as conditions will permit.

In the squad, fire control is exercised by the leader alone. In the section, fire control is exercised by the section leader assisted by the section guide.

24. Fire Control During Advance.—In the early part of the training in fire control, the squad or section remains in place. Individuals move about when necessary, but the unit as a whole does not advance. The unit acts as though in defense, or as it would during a pause in the advance.

The fire fight is usually begun by the scouts sent forward by the squads of the leading sections. In the approach formation, these men are well in advance of the section. When the scouts are in good fire position, the remainder of the section advances thereto by infiltration.

Within each squad, in such a case, the automatic rifleman goes forward first, the substitute automatic rifleman second, and the squad leader usually next. The second in command is last. The squad leader estimates the range or obtains it from the scouts, and sees that the other members of the squad get it as they come up. The section leader goes forward usually just after the automatic rifleman, but may advance at any time. The section guide is the last man to move on.

After the section is in a firing position and engaged with the enemy, the advance is made by short rushes of from 20 to 40 yards, by squad, by four men, or by two men, or by infiltration. When the section advances by rushes of two or four men, each fraction rushes the instant the preceding one hits the ground. When the advance is by squad rushes, it will be advisable to wait until the preceding squad has taken up the fire. Rushes of two or four men will be more generally used than those of the squad. Men fire until it is their turn to rush, being careful not to endanger the groups which precede them.

25. Fire Control, Difficulties Caused by Movement.—In advancing, the section is divided into a forward and a rear portion, separated by the length of the rush. The section leader overcomes this difficulty by going forward to control the fire of the forward portion, leaving the section guide to control the fire of the rear portion.

Positions reached by rushes under fire are very hurriedly occupied, and there is danger that men seeking good cover from the enemy will find themselves equally well concealed from their own leaders. The fire of such men is not subject to control. The squad leader notes the position taken by each man in his command, and for himself selects a location from which he can see all of them or as many as possible. If there is then a man who cannot see the squad leader, that man changes his position until he is able to do so. In this way the fire control of the squad is preserved. If the positions personally occupied by squad and

section leaders are not such that the section leader can see each of his squad leaders, these positions must be changed if proper fire control is to be maintained.

As the advance continues, the range to a stationary target will decrease, and provision must be made for changing the sight setting at proper intervals. It will not be necessary to change the sights for every rush. Accuracy in sight setting is more important at the longer ranges than at close ones. At distances beyond 500 yards, it is advisable to change the sight setting every 50 yards. For ranges between 500 and 300 yards, a change every 100 yards will be sufficient. Under 300 yards it will seldom be advisable to cease firing to change the sight setting, as most rifles require very little change in elevation for ranges under 300 yards. Sight changes are habitually made after the rush, although the squad leader may direct that they be done beforehand for good reason, such as poor cover in the new position in comparison with that of the old. Not more than two men of the squad cease firing to alter their sights at any one time. Orders for adjustments of sights and for fixing bayonets are executed before they are passed on.

26. Duties of Leaders.—In the maintenance of fire discipline and fire control, as well as in other phases of musketry, some duties are more important than others. The following is an enumeration of some of of the duties which apply to the section leader, the section guide, and the squad leader.

The primary duties of the section leader relate to the enemy and to the most effective use of the fire power of his unit. He carries out orders of the platoon leader; he selects firing positions; he determines ranges; he designates targets and issues fire orders; he controls the fire of the section; he observes the enemy and the effect of fire; he prevents exhauston of ammunition; and he replaces leaders who are casualties.

The primary duties of the section guide relate to individual conduct and discipline of the section. He assists the section leader; he maintains fire discipline; he controls the rear portion of the section during the absence of the section leader; he keeps on the alert for signals from the platoon or section leader; and he replaces the section leader leader when he becomes a casualty.

The squad leader carries out the orders of the section leader. He selects firing positions for his unit; he controls its fire and maintains fire discipline; he observes the enemy and the effects of fire; he keeps on the alert for signals from the section leader; and he participates in firing only in emergencies when the fire of his rifle is considered more important than the supervision of his squad.

27. Fire Distribution.—In musketry, hand in hand with fire discipline and fire control, goes fire distribution, which is the application of fire to the whole extent of a line target. Proper fire discipline means that all parts of the target are at all times kept under effective fire.

The enemy will usually be found in an irregular line of individuals or small groups. Some of these may be visible, but others will not. Without a definite system of fire distribution the latter will escape the effect of our bullets. Firing unmolested, these unseen men are the most dangerous of the enemy. A proper distribution of fire over the whole of the target will cause more casualties and greatly reduce the effect of the hostile fire.

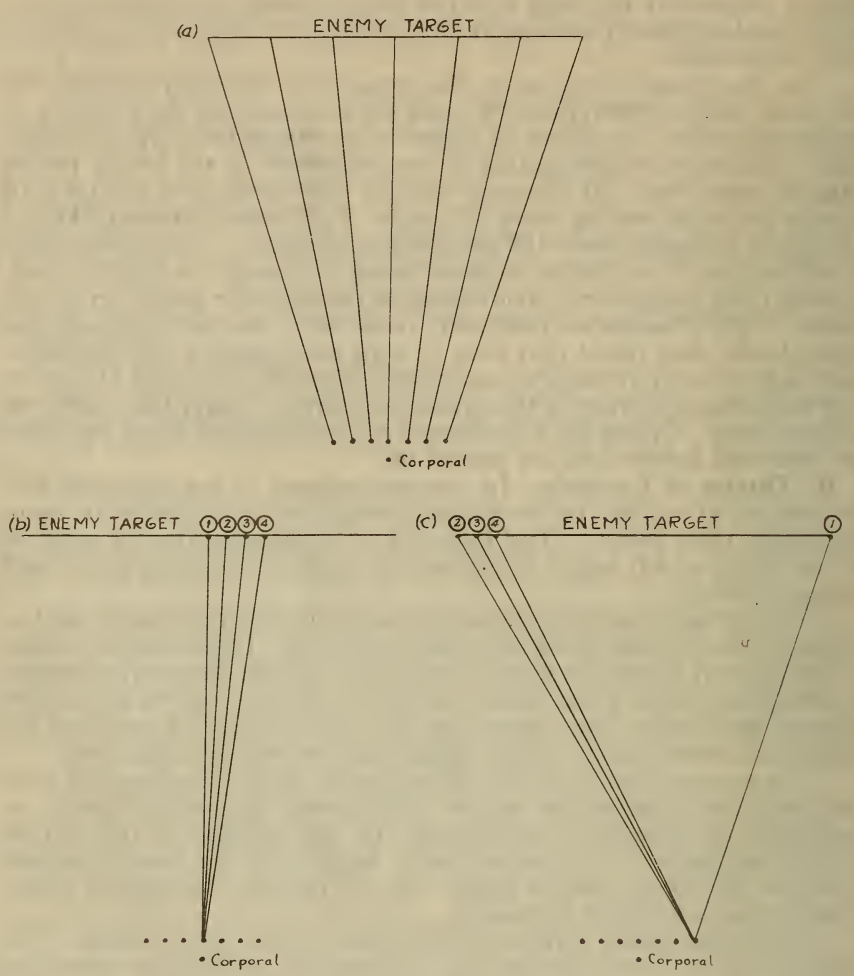

Figure 2 — Distribution of individual fire

28. Method.—Distribution is a matter for the individual and for groups. When the enemy is first engaged at the longer ranges each man fires on that point of the hostile target, taken as a whole, which corresponds to his own individual position in the squad; this is exemplified in Figure 2(a) which shows the location of the first shot of each individual in the squad. As the fire is continued, individuals successively change their aiming points a few paces to the right for each succeeding shot. Each man continues this method of distributing his fire until it reaches the extreme right of the enemy target. When this occurs, each then successively switches his aiming point from the extreme right of the enemy target to its extreme left. Individuals then continue, as before, firing along the hostile target's front, changing

their aiming points a few paces to the right for each shot. The approximate position of the first four shots of a man located in the center of a squad would be something like that shown in Figure 2(b), and marked 1, 2, 3, 4, while the positions for the first four shots of a man whose location is on the extreme right of a squad would be such as shown on Figure 2(c), and likewise marked 1, 2, 3, 4.

Figure 3 represents the squads of a section, each squad covering with its fire the entire front of the hostile target. This illustration makes apparent the practicability of keeping a section target continuously under fire by the method of squad distribution described above; thus, from the illustration, we see that should squad No. 1 rush forward, the target will still continue to be covered in its entirety by the fire of squad No. 2. Distributed fire is habitually employed against line targets; there is no special command for its use.

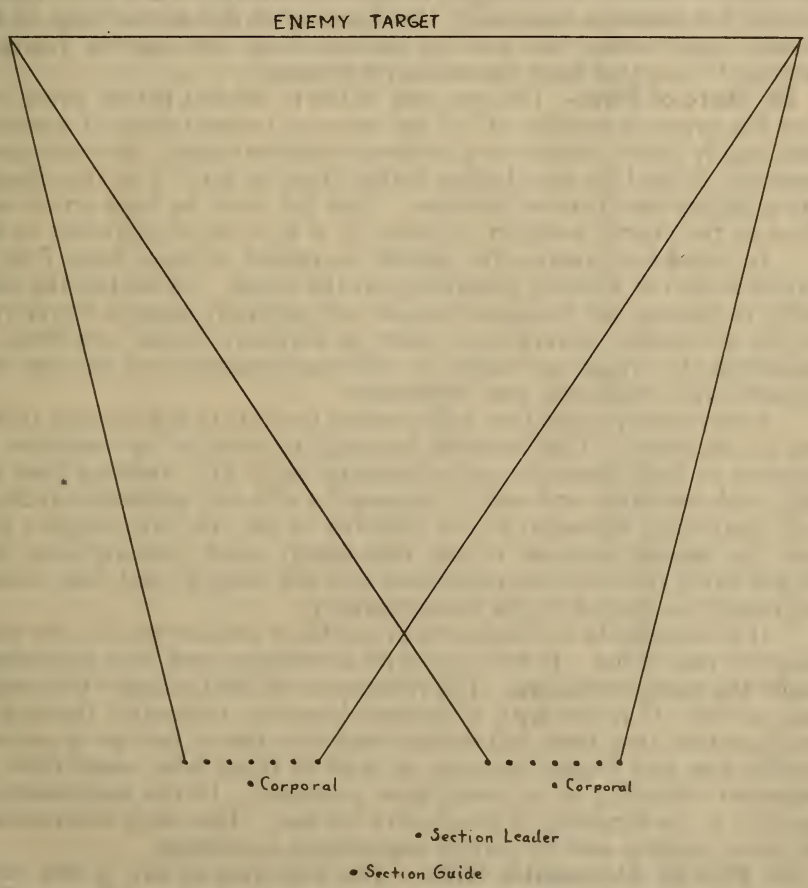

Figure 3 — Distribution of section fire

When a section is still distant from the enemy, individuals and squads may, in the manner just described, bring fire to bear on any part of the target without being interfered with by the movements forward of friendly units on the right or left. This, however, is not the case at the closer ranges. There comes a time, usually when about 150 yards from the enemy, when the movements forward of friendly troops on the right and left interfere with the attempts of individual fires to cover the whole of the target. When this time arrives, individual riflemen cease their attempts to cover the entire target, and limit themselves henceforth to shooting stright to the front.

Each individual, in attempting to fire straight to the front will in reality, spread his fire over a small sector. Thus it will occur that squads will in actuality cover an enemy frontage slightly in excess of their own frontage. This will result in the sectors of fire of the individual squads of a section overlapping slightly; and since the section will ordinarily be firing on an enemy of approximately its own size, the final result will be that the whole of the target is kept continually under fire. Before frontal fire becomes necessary, this keeping of the entire front of the enemy target under fire can be facilitated by limiting the fractions rushing forward, of from two to four men each.

29. Rate of Fire.—The best rate of fire in combat is that which will give the greatest number of hits per minute, unless failure of ammunition supply makes it necessary to conserve ammunition. In exceptional cases fire is used for moral effect rather than for hits. For this class of fire a higher rate is more effective. The fire must be kept on or very close to the enemy position, however, if it is to have any effect at all.

In rapid-fire practice the soldier is trained to shoot from 7 to 10 aimed shots per minute, depending on the range. In battle, the difficulty in picking out indistinct targets will generally make a slower rate of fire advisable. Every shot must be carefully aimed and fired by squeezing the trigger as taught in rifle marksmanship, or the fire will become wild, scattered and ineffective.

Everything is done that will increase the rate of fire without reducing its accuracy. This includes keeping the muscles in condition by exercise in bolt operation and simulated rapid fire; insisting that the bolt work smoothly and easily; keeping the rifle and ammunition clean, with particular attention to the chamber of the rifle; keeping the bolt and the bearing surfaces of the rifle lightly oiled; making sure that proper firing positions are taken and that the sling is used; and reloading rapidly as taught in rifle marksmanship.

It is impossible for leaders to prescribe or enforce exactly the most effective rate of fire. It will vary with conditions, and with individuals under the same conditions. The rifleman is the best judge of the proper rate of fire. It is the duty of leaders, however, to control the rate to to the extent that they will correct men who fire so fast as to prevent careful aim and trigger squeeze, as well as those who waste time by improper reloading or by using poor positions. In the excitement of battle it is the tendency of men to fire too fast. This must be overcome by prior training and by careful supervision in combat.

30. Fire of Automatic Rifle.—The high rate of fire of the automatic rifle makes it important in maintaining fire power. Every effort is made to keep the automatic rifles in action. The automatic rifleman distributes his fire in the manner described for riflemen except that he fires two or three shots at each aiming point before shifting to the next.

31. Characteristics of Rifle Fire.—A good workman knows his tools and understands their use. The soldier having been taught the use of his rifle, must learn something of the action and effect of bullets. He must also know the different kinds of rifle fire and their use, if the best results are to be obtained.

32. Trajectory.—The trajectory is the path followed by the bullet in its flight through air. As has been said, the bullet leaves the rifle at the tremendous speed of 2,700 feet per second; and because of this speed the trajectory at ordinary ranges is very nearly straight or flat. When fired from the level of the ground on a flat plane and at a target on the surface of the ground 1,000 yards distant, the bullet will rise to a height of only 12.3 feet.

Figure 4 shows trajectories for several ranges. For covenience, the vertical scale is made 20 times the horizontal. This difference in scale means that vertical distances and the curvature are exaggerated 20 times in the drawing. The figures showing the height of trajectory are correct, but it must be remembered that the path of the bullet is not curved as shown, but is almost straight. The great advantage of a flat trajectory is that the bullet sweeps close to the ground and covers several hundred yards effectively with one sight setting.

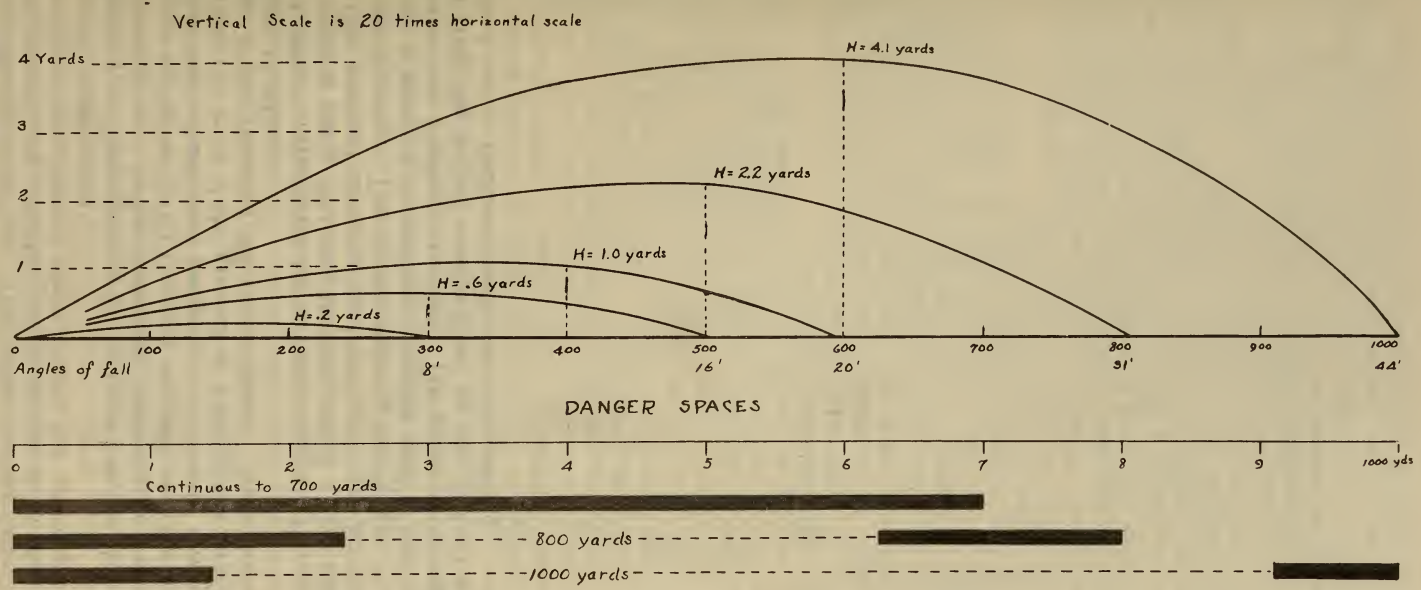

Figure 4 — Trajectory Diagram

Ball Ammunition M1 - 172 grain bullet

33. Angle of Fall.—The angle at the target between the tangent to the trajectory and the horizontal is called the "angle of fall." For all practical purposes, with the rifle the angle of fall is measured between the trajectory and the straight line to the gun. On account of the flatness of the trajectory, this angle will be very small at other than long ranges. Angles of fall are given in Figure 4. When the gun and target are on the same level and the slope of the ground at the target is the same as the angle of fall, the bullet will sweep along the ground a long distance. A greater slope of the ground surface will mean that it is not covered by fire at all.

34. Danger Space.—Since the trajectory for a range of 700 yards does not rise above the height of a man standing (68 inches), it follows that, on level ground, all the space between the gun and target is dangerous; thus the "danger space" for ranges up to 700 yards is continuous. For ranges of 800 yards and more the bullet does rise above the height of a man, so that only parts of the space between the gun and target are dangerous. The danger space then consists of two parts: first, the space from the rifle to the point at which the bullet rises to the height of a man, and second, the space from the target to the point at which the bullet again falls to the height of a man. Danger spaces for several ranges are indicated at the bottom of Figure 4. If the enemy troops are kneeling or prone the danger space will be reduced accordingly.

35. Dispersion.—Experience shows that it is impossible for any man, and especially for any group of men, to fire a number of shots so that all the bullets will follow exactly the same path. Differences in rifles, ammunition, aiming, and holding cause the bullets to scatter or disperse slightly. This effect is called "dispersion." Dispersion may apply to a single rifle or to a group of them. Dispersion is greater in the case of the group, because there are more variations to cause it.

If tracer ammunition (bullets treated with a phosphorescent preparation which makes them visible in flight) should be used in firing rapid fire scores on the target range, a man watching from a distance, and to one side, would see the tracers as a long, narrow cone of fire. The point of this cone would be at the firing point, and its base at or beyond the targets. This figure formed by the cone of fire is called the "cone of dispersion."

36. Shot Groups.—When the cone of fire strikes a target, the bullets forming the cone will make a pattern upon it. This is called a "shot group." Groups made in firing on the rifle range are called vertical shot groups because they are made on a vertical target. Shot groups made on a horizontal target or surface are called horizontal shot groups. Because of the flatness of the trajectory, horizontal shot groups have a length of from 100 to 400 yards, depending chiefly on the range. For ranges not exceeding 1,000 yards, the length of the horizontal shot groups decreases when the range is increased. The hits are not spread evenly over the entire shot group but are much closer together near its center. This is true of both vertical and horizontal patterns.

37. Beaten Zone.—The "beaten zone" is the ground area struck by bullets forming a cone of fire. The slope of the ground has a great effect on the shape and size of the beaten zone. Rising ground shortens it. Falling ground will escape fire unless its slope is less than the downward curve of the trajectory at the point considered.

38. Kinds of Fire.—*a.* Rifle fire as regards direction is roughly classified as follows:

(1) Frontal—fire delivered at right angles to the front of the enemy lines or other objective.

(2) Oblique—fire delivered at an oblique angle to the front of the enemy lines.

(3) Enfilade—fire delivered at the enemy from a position on or near the prolongation of his line.

(4) Flanking—fire from the direction of the flank; especially fire used to sweep along the front of a defensive line and thus enfilade the attackers as they approach a position.

(5) Reverse—fire delivered so as to strike troops from their rear.

b. Fire as regards trajectory is classified as follows:

(1) Grazing—fire which is approximately parallel to and close to the ground.

(2) Plunging—fire which strikes the ground or other material object at a considerable angle.

(3) Overhead—fire delivered over the heads of friendly troops.

c. Oblique fire is slightly more effective than frontal. Enfilade and flanking fire are more effective than oblique. Grazing fire is more effective than plunging, because the beaten zone is much longer. Overhead fire with the rifle is safe when the ground affords protection to the friendly troops in front, or when they are a sufficient distance below the line of fire. Greater risks are taken in war than are advisable in training.

39. Effect of Rifle Fire.—The effective range of the rifle is limited by the ability of troops to make hits, rather than by the disabling power of the bullet. Fire is very seldom effective at ranges of 600 to 1,000 yards, on account of the difficulty of seeing and hitting enemy troops. At a range of 1,200 yards the bullet will go through eleven pine boards, each one inch thick and spaced one inch apart; at a range of 2,500 yards the bullet will generally penetrate two such boards, which indicates that it still has enough force to disable a man. A ricochet is effective if it strikes a man soon after leaving the ground. Ricochets lose their speed quickly, however, and are apt to be ineffective after traveling a considerable distance.

Rifle fire is seldom used to advantage against enemy material. Well-constructed defenses are bullet proof, and cannot be destroyed by rifle fire. The bullet is often effective, on the other hand, against the light armor or helmets worn by individuals. Its effectiveness depends on the range, on the metal used in the armor, and on the angle at which it strikes.

At times rifle fire is effective against low-flying airplanes, and should be used against them. Airmen say it is very demoralizing to pilots.

40. Moral Effect.—At ordinary ranges the sound of a bullet passing within a few yards is a sharp, disconcerting crack. In the field, bullets which fall a little short will usually throw up a shower of dirt or stone, and ricochet with a loud whine or hum. If troops under fire have cover but must expose themselves in order to fire, they will have a tendency to fire quickly without careful aim and then to duck down behind the cover to reload. If the fire is very heavy, they may keep down altogether, and make no attempt to return it. Such action results from the fear of being hit and from unwillingness to take risks, when lying low seems to be the safest plan. Another effect of fire is that some men become excited and are unable to think clearly and act with coolness.

Fire sometimes indicates by its volume that the enemy is stronger, or by its direction that the enemy has the advantage of position. These are factors which cause discouragement. Fear, excitement, and discouragement, with the resulting loss of will power, are the chief factors in the moral effect of rifle fire. This moral effect can be obtained entirely without hits when the enemy is behind cover, but nothing increases it so much as hits. Consequently hits are the first consideration so long as the enemy, by exposure, makes them possible. When they can no longer be made, fire is continued when its moral effect alone is considered worth the effort and ammunition expended. When opposing forces are intrenched and neither side is trying to advance, fire for moral effect alone is of no value.

SECTION III

WEAPONS: MACHINE GUN CHARACTERISTICS.

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41. Browning Machine Gun.—A machine gun is an automatic gun firing small arms ammunition, and capable of delivering fire for relatively long periods; machine guns for use by ground troops against ground targets are equipped with mounts permitting the direction of fire to be clamped.

The type of machine gun in our service is the Browning cal. .30, M1917. It is recoil operated and water cooled; the ammunition is fed by a belt. The force of recoil, similar to what is commonly known as the "kick" in the shoulder rifle, is utilized to perform the various mechanical operations of withdrawing the cartridges from the loops of the web-belt, loading them into the chamber, cocking and firing the gun, and withdrawing and ejecting the empty cases through the bottom of the receiver. The gun is chambered for the cal. .30 M1906 ammunition.

The barrel of the gun is surrounded by a water jacket which holds about seven pints of water. This fluid absorbs the heat generated in firing the gun, and prevents the barrel from becoming overheated. When being fired, the Browning machine gun is usually mounted on its tripod. The weight of the gun is, without water, 30 pounds, and with water, about 37 pounds; the weight of its tripod is about 45 pounds.

In general, the Browning machine gun is characterized as being a rather light, portable weapon, firing rifle ammunition automatically at a high rate It is capable of a sustained fire, because of its recoil operation, water cooling, and tripod mounting. The mounting also allows

the gun to be clamped securely in any direction.

The rifle fires the same ammunition as the Browning machine gun and has the same mean trajectory. The rifleman thinks in terms of a single shot, however, whereas the machine gunner thinks in terms of a cone of shots. The cone from one or more rifles and the cone from the machine gun will differ greatly even though there are the same number of bullets in each. The dispersion of the machine gun is much less than that of an equal amount of rifle fire; thus the effective range of the machine gun is greater. Its weight, however, makes it far less mobile than the rifle.

The automatic rifle fires the same ammunition as the machine gun and at approximately the same cyclic rate, but its usable rate of fire and effective range are much less than for the machine gun. Its mobility is about the same as that of a rifle, and is greater than that of the machine gun. The automatic rifle, having no fixed mount, is not well adapted for overhead fire or indirect laying (to be explained later). On the other hand, the machine gun, because of its fixed mount and small dispersion, is suitable for these purposes.

It will be noted that the machine gun has greater fire power, greater effective range, and less mobility than the rifle or automatic rifle.

42. Mode of Action.—Machine guns act through fire power alone. They are a powerful auxiliary to a rifle unit. When only fixed fire is needed, it will be proper to use machine guns in conjunction with infantry mortars and supporting artillery, thus economizing in riflemen, who become available for tasks requiring movement. In the attack, machine guns assist in preparation, in gaining and maintaining fire superiority, in covering the advance, and in breaking up counter-attacks. In the defense they assist in covering the front and are an important factor of the framework of the defensive system. The gun has little power of destruction against matériel. It is generally employed, therefore, to keep down the fire of hostile infantry and machine guns, to destroy personnel in the open, to cover the front and flanks of strong points with flanking fire, to immobilize personnel under cover, or to deny to personnel the use of areas. In all of these activities, the employment of machine guns is coördinated with that of the other weapons, each being assigned missions and targets best suited to its powers and limitations.

43. The Mount and its Effect.—The fixed mount is a distinguishing feature of the machine gun. By means of it, the gun can be clamped in elevation and direction. This lessens the effect of the personal equation in firing, even when the firer is under the strain of excitement or fatigue. The fixed mount makes possible the small dispersion and the close grouping. Overhead fire can be used, within certain limits, without danger to friendly troops. The ability to maintain the laying in direction and elevation makes indirect laying practicable. This is an important feature. Direct laying (the usual way of employing a rifle) is the pointing of a firearm at a target which can be seen; indirect laying is a method used when the target is invisible to the gunner. Both these methods will be discussed later.

By virture of the mount, then, an effective fire can be placed upon a given line or area under all conditions of visibility. This is particularly useful in night firing, or when the target becomes masked by rain, fog, or smoke. Employment with outposts or in defense, where guns are laid to cover avenues of approach or sweep areas or lines through which the

enemy must pass, is an example of the application of this characteristic.

Accuracy and close grouping of shots can be obtained at long ranges, as the mount holds the gun firmly. Thus, favorable targets beyond the range of effective rifle fire may profitably be engaged by machine guns. In the attack, machine guns can take up the fire fight and cover the advance of friendly riflemen until they are within effective rifle range of the enemy. In the defense they can force the enemy to deploy at ranges where rifle fire would have little effect. Finally, fire may be adjusted by observing the strike of the bullets and then making necessary corrections.

44. Fire Power.—By merely pulling the trigger, 400 to 500 shots per minute can be fired. This is the "cyclic rate," and must be distinguished from the "usable rate" of fire. Two hundred and fifty rounds per minute is about the maximum usable rate of fire. The firing is done in bursts of from 5 to 50 rounds, with a pause after each burst to check the aim or to relay on other parts of the target. When engaging moving targets or those which require searching and traversing in order to cover them completely, the number of rounds the gunner is able to fire for any length of time is about 100 per minute.

The rifle equivalent is variable and depends upon the range and direction of the fire with respect to the target. It is ordinarily assumed that the fire effect of a single machine gun is equivalent to that of from 25 to 50 rifles. The rapidity of production and application of a large volume of accurate fire favors its use for surprise effect.

Because of its better cooling system and heavier mechanical construction, the machine gun, unlike the automatic rifle, is able to maintain a high rate of fire for a considerable period of time. Thus it is of value in preparation fire and in barrage firing, where areas or lines are kept under fire for a considerable length of time.

The expenditure of ammunition is very great. Ammunition supply must be carefully organized, and expenditure carefully regulated. This is not as difficult in the defense as in the attack, where ammunition must be carried forward in limited quantities.

Stoppages or accidental cessations of fire constitutes an unfavorable characteristic which must be considered in connection with fire power. This liability to stoppage, together with tactical considerations, makes it advisable to use machine guns in pairs. Generally both guns of the section are assigned the same target or sector, so that in case of the stoppage of one piece the other may continue the fire.

45. Cone of Fire and Beaten Zone.—Small dispersion, a high rate of fire, and a rather flat trajectory give a narrow dense, cone, with a resulting long, narrow, and compact beaten zone. When firing over level or uniformly sloping ground at a range of 700 yards, the height of the cone above the ground does not exceed the height of a man.

As the range increases, the trajectory becomes higher and higher to such an extent that fire over masks such as hill, woods and houses, by indirect laying may be employed. With certain limitations for safety, it is practicable to fire over the heads of friendly troops.

The machine gun can be used to fire on points or areas where the enemy is or is expected to be. It is not suited for sniping, or for firing on small unimportant targets

The small dispersion of the gun has a direct bearing upon the accuracy with which the range must be determined. At the longer ranges a slight error in range or direction will throw the cone off the target.

Machine gunners must be highly trained in range estimation and more important still in the operation of the range-finding instruments with which they are equipped.

46. All-around Traverse.—The Browning machine gun may be turned in any direction without moving the mount. While this is not literally true of all machine guns, still the ease with which the direction of fire may be changed justifies the statement that all of them have an all-around traverse. This quality makes for flexibility of fire. Counter-attacks on the flank, or unexpected targets in any direction, can be quickly engaged without movement, or with only slight movement, of the gun and crew. Guns located on the flanks are able to cover gaps between units or to protect the flanks when one element advances farther than another. This wide arc of fire of the machine gun, together with its great fire power, makes it particularly valuable in defense, outposts, and rear guards.

The great fire power of the machine gun is in the hands of one man, the gunner, who is able to turn it in any direction. Control, therefore, is simple. Fire orders are more easily transmitted to this single man than to an equivalent number of riflemen.

47. Mobility.—The methods used to move machine guns and their ammunition are by Cole carts, by packs on mules, by motor transportation, and by hand.

When carried by the first method over open terrain, machine guns have almost the same mobility as the riflemen they accompany.

When it becomes necessary for the crew to carry the guns and equipment, the mobility of the gun is less than that of the riflemen. To lessen this disadvantage, leaders must be resolute, and the crews must consist of robust men exercised in carrying full equipment. Then leaders must be taught to select easy, defiladed routes of advance permitting use of transport to the fullest extent; all personnel must be trained, as well, to move into position under cover. In action, movement by hand is frequently necessary, since guns which are in close support of the rifle companies are seldom able to get to their positions on transport. Over terrain where the transport cannot follow closely, the entire movement is by hand.

Machine guns are not able to open fire quickly except when mounted in their firing positions. In the attack, movement into position requires time, because the guns are kept far enought in rear to enable them to move to suitable firing positions without marching by the flank. Careful reconnaissance by platoon leaders in advance of their commands insures prompt action on the part of the machine guns, and close support of the rifle companies.

48. Vulnerability.—In route column, machine-gun units are very vulnerable to machine gun or rifle fire. In advance guards, rear guards, approach marches, or withdrawals they will be so placed in the formation that they will not be surprised and immobilized or destroyed by small arms fire. In our service they are, in principle, covered by the rifles of a battalion when on the Cole carts.

When it is emplaced, in the defense or in the attack, two or three men are sufficient to operate the gun. Casualties among the crew will not decrease the fire power so long as ammunition is at hand. All members of the squad must be trained to handle the piece, and replacement of casualties should be automatic in a well-trained squad. The gun, with two men to operate it, occupies but a few square feet, and

when well concealed is hard to locate and difficult to destroy. Machine guns are carefully watched for by the enemy, and promptly draw fire when located either in or out of action.

49. Ease of Concealment.—The small area occupied by the machine gun and the men required to serve it makes possible the effective use of the slightest cover. Such features as folds in the ground, weeds, and debris will conceal a machine gun from view. On the other hand, the distinctive noise of the gun, the dust from the muzzle blast, the steam, and the flash (at night) tend to disclose the position. There is much that may be done to lessen these disadvantages, however. When time permits, all of these unfavorable characteristics, except noise, can be effectively guarded against. With effective concealment, the noise discloses the presence of the machine gun but not necessarily the location of the position. Emplacement, either hasty or permanent, are small and not difficult to conceal. In cramped localities, a machine gun may be placed where an equivalent number of rifles could not find room.

50. Moral and Physical Effect of Fire.—The moral and physical effects of machine gun fire are greatest when the fire is delivered with great volume at close ranges, with surprise effect and in enfilade. The physical effect may often be increased by anticipating the probable actions of the enemy after the opening of fire; for example, if fire is delivered on a column which is near cover, such as the edge of the woods, it may be expected that the enemy will seek this cover. If the machine gunner, in this case, anticipating the action of the enemy after fire is opened, shifts to the edge of the woods and lays down a band of fire so as to deny entrance to the woods, he will inflict additional casualties on the enemy as they attempt to gain cover, thereby increasing the physical effect of the fire. The moral effect of the fire is greatest when it causes great losses in a short space of time, or is of such accuracy and intensity as to cause the enemy to have no thought except that of self-preservation. Fire is successful when it causes the enemy to abandon his purpose.

51. Favorable Machine Gun Targets.—Favorable machine gun targets are deep and dense. Groups of the enemy that bunch together, and column or lines taken in enfilade, present the most favorable targets. It must be borne in mind that ordinarily it is the position of the target with respect to the gun, rather than the shape of the target, which will determine it vulnerability to fire. For example, a skirmish line engaged by frontal fire is a poor target, whereas if engaged from a position on the flank it may be a good one. The greater effective range of the machine gun as compared with the rifle makes it possible to engage targets which are unfavorable for rifle fire. As the enemy will never knowingly present deep targets, it must be expected that they will usually be obtained by skillful selection of gun positions.

52. Unfavorable Machine Gun Targets.—The machine gun has little or no destructive effect against matériel. It is usually ineffective against tanks or artillery in position, but may under favorable circumstances immobilize matériel which is animal drawn or served by men not protected by armored shields. Hostile machine guns, although unfavorable targets, may be effectively engaged and put out of action, or at least compelled to change position. Fire should preferably be directed against personnel or against areas to be denied to the enemy. When the enemy assumes any formation which presents a frontal target with wide intervals between them, he is least vulnerable to machine-gun

fire. In practice the machine gunner will often be forced to engage unfavorable targets. His problem is to accomplish the maximum possible results most economically and effectively. Unremunerative targets such as scouts, observers, small patrols, and the like should not be engaged unless their activity is not suppressed by rifle fire and, further, unless it is important to put them out of action.

53. Summary.—Too much stress cannot be laid on concealment and surprise effect. The small size and great fire power of the machine gun adapt it to this method of employment. The rapid, regular explosions of the gun, together with the crackling of the bullets in the air, have a decided psychological effect on the enemy, on the troops it is supporting, and on the gunner himself. The gunner soon acquires a sense of power and invulnerability. This confidence must be encouraged. The machine gunner should be taught that in the attack his support is extremely valuable that in defense it is decisive; that during the hostile advance to the assault, machine guns assist materially in breaking up the attack; and that during the assault they are greatly relied upon to repulse the assault by flanking fire.

SECTION IV

WEAPONS: MACHINE GUNS

DIRECT AND INDIRECT LAYING

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54. Direct Laying, General.—As already indicated in paragraph 43, there are two general methods of laying the machine gun, or, in other words, there are two systems to be followed under different circumstances for so directing the machine gun that, when fired, the desired target will be struck. The first is direct laying and the second is indirect laying. The first is used when the gunner can see the target; it is also used when he can fix his sights on a place that is visible to him but on which he may wish to fire later when he cannot see it—as at night. The second applies when the target or place on which fire is later to be delivered is invisible to the machine gunner because the line of aim is obstructed by a mask, such as hills, woods, smoke, fog or darkness.

Specifically, direct laying consists in pointing the gun for direction and elevation by directing the line of sighting upon a given target. This method possesses distinct advantages over indirect laying. In the expenditure of any given amount of ammunition, the number of hits to be expected with direct laying is considerably greater than when indirect laying is employed. The location of the target being visible, the guns can of course be more quickly and easily laid on it. Moreover, fire can be observed and readily adjusted to obtain the maximum possible fire effect. Again, rapidly moving targets, such as aircraft and

mounted troops, can be engaged and followed with fire, because of the ease with which the cone of fire can be shifted. As indirect laying is usually ineffective against rapidly moving targets the direction of whose movements is not restricted, it is not normally so employed. Tracer ammunition, which outlines the cone, enables the gunner to place his fire on fast moving objects without reference to the sights. Another and great advantage is that guns employing direct laying are usually in such a position that the gunner can see the movements of friendly troops. This enables machine gun units to keep in closer touch with the needs of the rifle elements, thus making it possible to give the latter better support in firing over the heads of friendly troops.

The most serious disadvantage of direct laying is the difficulty of securing cover for the guns. It is probable that when the gunner can see the enemy, the enemy can also see him. An enemy on the defensive moreover, will have the advantage of better cover, whereas troops in the attack are more or less forced to disclose their positions and movements. Muzzle blasts, steam, and the unmistakable sound of firing tend to reveal firing positions, unless proper measures are taken to minimize these unfavorable characteristics.

Another disadvantage of direct laying as compared with indirect is the relatively greater difficulty of controlling the fire of several guns and keeping up the supply of ammunition and water. As far as the situation permits, batteries of guns organized for direct laying are located with a view to facilitating control and supply.

The possibility of observing the target and the effect of fire, and the consequent simplicity of fire adjustment, give to direct laying a relatively greater efficiency than that possessed by indirect. Taking into consideration the number of casualties inflicted upon the enemy within a unit of time with a given ammunition expenditure, it may be laid down as a general rule that fire with direct laying is much more effective than fire with indirect. It is the normal type of laying employed in battle. It should always be used in preference to indirect laying when a practicable choice exists between the two types. However, indirect laying should supplement direct, whenever there is a possibility of the failure of the latter because of smoke or darkness masking the target.

55. Cone of Fire and Beaten Zone.—The machine gunner must be able to form a mental picture of the cone of fire which he is sending out, and must further have the ability to visualize the beaten zone; this will aid greatly in securing effective fire delivery. It is useful to remember that the effective beaten zone (82 percent of the whole) is about as shown in Figure 5 and that the maximum ordinates of the trajectory, which always occur at about three-fifths of the distance from gun to target, are approximately as shown in Figure 4.

In visualizing the cone, it is well to remember that when fire is placed on a target at a range of 700 yards, the cone does not rise higher than the height of a man, and that the length of the effective beaten zone for this trajectory extends the continuous danger space to about 800 yards.

The characteristics of machine-gun fire are such that correct range determination is of importance. Beyond ranges of 700 yards correct sight settings must be used, particularly when, on account of poor visibility, the gunner is not able to adjust the fire. In such cases the cone of fire may miss the target completely if there is a large error in range determination.

Since the beaten zone is comparatively short between the ranges of 1,500 and 2,500 yards, an error of over 100 yards in range determination may result in completely missing the target or at least seriously reducing the fire effect.

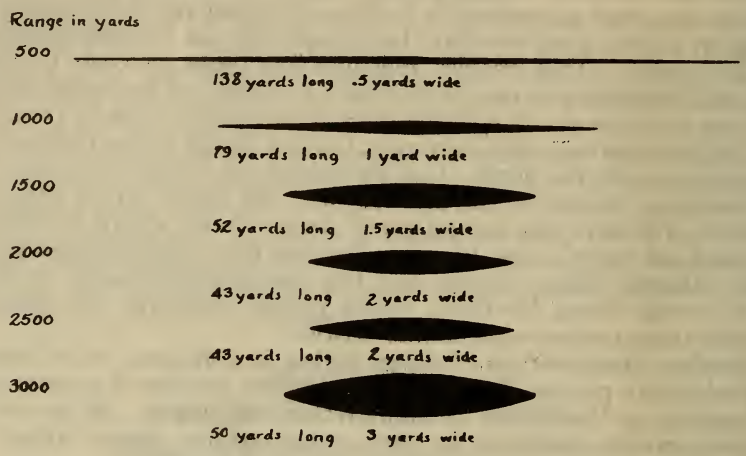

Figure 5 — Table of approximate beaten zones on level ground
172 grain bullet

56. Range Determination.—Ranges may be determined by any one of the following methods: By estimating the distance by eye, by range-finding instruments, by fire for adjustments, by taking the range from a map, and by measuring the range directly on the ground.

In using direct laying, the means of range determination usually employed are estimation, range finders, and fire for adjustment. The estimate of the range determined by the range finder should be checked by fire for adjustment whenever possible. When observation of fire is possible and surprise effect is not important, determination of the range by fire for adjustment will give the best results, because the gun itself, under favorable conditions, is the best range finder.

57. Classes of Fire.—In Figure 6 are pictured the different classes of fire which a machine gun can deliver; these apply of course, both to direct and indirect laying.

58. Fire Distribution.—Fire, to be effective, must be distributed over the entire target. Improper distribution results in gaps between beaten zones, and allows a part of the enemy to escape or use its weapons unhindered by fire. With machine gun fire, on account of the compactness and density of the sheaf, this is of special importance, since without proper distribution, ammunition will be wasted by throwing too many bullets into one part of the target, while the remainder of the target is untouched.

As a rule one gun cannot effectively cover a target subtending more than 50 mils except at very short ranges. This is due to the time required to traverse more than 50 mils, and to the relatively small volume

of fire that can be delivered from a single gun. Also, whenever practicable, at least two guns should be assigned the same mission. This arrangement insures the continuous accomplishment of the mission should either gun be put out of action by stoppages or enemy fire. It also provides a more decisive volume of fire.

59. Overhead Fire.—Overhead fire, as has been said, is fire delivered over the heads of friendly troops. It may be delivered by either direct or indirect laying. Machine guns are capable of delivering overhead fire by virtue of their fixed mounts and the consequent small and uniform dispersion of the cone of fire. The use of overhead fire increases the radius of action of machine guns, as the guns are not confined to the line with the troops which they are supporting; positions can be selected in rear which afford a fuller utilization of the fire power of the weapon. Moreover, in attack, overhead fire permits machine guns, without moving, to continue the delivery of supporting fire during the advance of rifle units.

Overhead fire must be so directed and controlled as to give every reasonable assurance of safety to troops over which the fire is directed; and it must allow the movement of patrols and skirmishers and permit small maneuvers of a local character. Should the fire be so close to our troops as to cause losses, the object might be defeated by preventing the troops from advancing or from even holding their ground. For this reason, it is necessary to place the fire at such a distance over their heads that the conditions of fire delivery incident to the handling of the guns in battle will not allow hits among our troops.

60. Fire Control.—Whether using direct or indirect laying methods, fire control of machine guns implies the ability on the part of the leader to throw the fire of his guns upon the target, shift it from one target to another, open fire, regulate the rate of fire, and cease firing, at will. Proper control can only be obtained when all ranks are disciplined and obedient to the will of the leader and have, moreover, the necessary technical skill to carry out the fire orders. Fire should not be opened without command except when the circumstances of battle make control by the leader impossible. Unless the leader controls the fire, much of its effectiveness will be lost through misapplication in engaging unimportant targets, or in neglect of important ones.

The leader may use any method of control suitable to the situation. Verbal orders are employed either alone, or in conjunction with signals when it is possible to control the unit by word of command. Written or verbal messages transmitted by messenger may be used to give fire instructions when guns are so separated as to render impossible the direct control by word of command. When situations are foreseen and plans can be made to cover future events, such as when engaging targets on a time schedule or upon rocket signal, fire may be controlled by gun charts which prescribe the order and time of firing, or by range cards which give the distance and direction to key points within the field of fire.

It must be understood that in battle it will often be impossible to control guns by verbal or signaled orders. In many instances control must be decentralized, and the proper leader (sergeant or corporal) given only the mission. During training, in some maneuvers and certain exercises, special situations should be drawn which will require the guns to go into action without verbal orders of the larger unit leaders.

61. Adjustment of Fire.—Observation of target and fire for both direct and indirect laying is continuous throughout the action. It is performed by all directly concerned with fire delivery. The gunner observes and corrects his own fire whenever possible. The squad leader takes post where he can observe the fire of his gun, and communicates with the gunner and section leader. Section leaders take post so that they too can see the effect of the fire, and can communicate with their squads. The service of the gun and transmission of orders are facilitated by close grouping of guns in the occupation of a position.

62. Indirect Laying, General.—Despite the fact that direct laying is in general preferable to indirect and even when no concrete solid mask, such as a hill, renders the target invisible, supplementary indirect laying methods must still be provided for when guns are primarily sited for direct laying. This is true because the attack, our own or the enemy's, is frequently made under the screen of darkness, fog or smoke which may obscure the target and so interrupt direct laying fire by reason of poor visibility. Furthermore, situations sometimes arise in which the terrain does not afford positions suitable for guns using direct laying; in such cases, the fire power of machine guns would be lost were it not for the fact that by the employment of indirect laying, all guns can

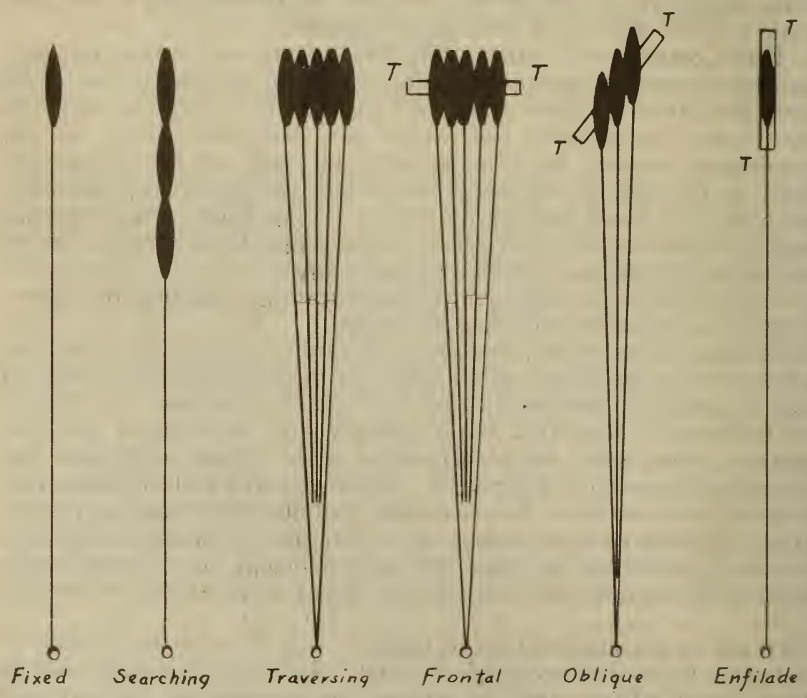

Figure 6 — Classes of machine gun fire

usually be brought into action, since in using this method gun locations are not restricted to places from which the gunners can see the targets. Thus it may be seen that the use of indirect laying in effect increases the area available for machine gun positions. This lifting of restrictions as to gun locations gives to indirect laying one of its important advantages, as this in effect increases the area in which possible machine gun positions may be found. Moreover it permits the massing of a greater number of guns for the attack or defense, and so increases the amount of fire that can be delivered. Another advantage of indirect laying is that it permits fire at longer ranges than can be obtained by the direct method; this follows because in indirect laying dependence is placed on accuracy of calculation and not on observation. Finally, machine guns using indirect laying are not as exposed to view as when firing by direct laying methods, and so can be more easily concealed; even so, however, cover for the gun and precautions for the concealment of the muzzle blast and the escaping steam must not be neglected.

SECTION V

WEAPONS OF HOWITZER PLATOON

Paragraphs

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The 3-inch mortar 64
New weapons 65

63. The 37m/m Gun.—The 37m/m gun, M1916, is a flat trajectory weapon of the field gun type which fires high explosive or low explosive shells or solid projectiles weighing slightly more than one pound. It is essentially an infantry weapon and is of such weight and construction as to accompany the infantry battalion on the march or in the attack. In the Marine Corps, it is transported on a carriage mounted on two wheels with pneumatic tires, hauled by hand, or split up into its component parts and carried. There is only one such weapon in the battalion machine gun and howitzer company.

The 37m/m gun is a very accurate weapon; it also is easily and quickly adjusted when good observation is obtained. This is especially true when the common steel shell is used, for its explosion gives a small cloud of white smoke which is very distinctive, and which may be easily located, even at long ranges.

Although the maximum range of the gun is about 4,000 yards, its effective range is usually 1,500 yards, because of the limits of observation, but with good observation the gun is effective up to 1,800 to 2,000 yards. The sights for the weapon are graduated to 2,000 yards, and in firing at longer ranges than this it is necessary to improvise means of laying for elevation. The maximum rate of fire which can be expected under combat conditions is about 20 rounds per minute after fire has been adjusted. This depends upon the type of target, its visibility, and whether direct or indirect laying is used.

There are two kinds of shell; the high explosive, which has a bursting charge of TNT (trinitrotoluene), and the common steel shell, which has a bursting charge of black powder.

The effective bursting radius of each of these types is about five yards. Within this radius the high explosive shell is more effective, as it breaks into a larger number of fragments and has a greater concussion. The common steel shell is particularly useful for registration

when visibility is poor, as it has a more distinctive burst because of the white smoke from the black powder in the bursting charge.

The primary use of the 37m/m gun is against enemy matériel, not personnel. In addition to its accuracy and bursting effect, it has relatively great shock and penetrating power; its shell will go through ½ inch of steel armor at 300 yards. Because of this fact, together with its accuracy, it may be of assistance in destroying tanks, and is particularly effective against such light matériel as machine gun nests, trench mortars, and weapons corresponding to the 37m/m gun itself. As the effective radius of burst of its shell is so limited, its use of fire on enemy personnel other than in close formations, such as a squad or a larger unit in close order, is not encouraged.

The gun is normally fired on its tripod, but may be fired from its wheels if necessary. It can be concealed easily and quickly, taking advantage of shell holes, folds in the ground, and other cover. The 37m/m gun delivers fire from a position behind a mask by use of the quadrant sight. Full advantage is taken of this characteristic, and this type of fire is used whenever time is not an important element. When it becomes necessary to engage a target without loss of time, direct laying is used, or the piece is fired from a mask position with sight defilade only.

The flash of discharge is especially noticeable at night, and, if precautions to hide it are not taken, may lead to the location of the gun by the enemy. This feature may partly be overcome by use of the "flash hider," a device which, while not entirely eliminating the flash, to a great extent prevents the illumination of surrounding objects. If the ground under and in front of the muzzle is dry, the muzzle blast will raise a cloud of dust, which obscures the gunner's view and discloses the position of the gun. This can be prevented either by thoroughly wetting the ground or by spreading wet sacks under and in front of the muzzle.

Since the gun is drawn by hand, its mobility is slightly less than that of the rifle company, and it can accompany them only when the ground is level and firm. During the progress of an attack the gun can keep up only if the progress is slow. It may be split up into its component parts and carried, however, when the condition of the terrain or other features of the tactical situation prohibit the use of wheels. This method should be employed only during the final short movement to the firing position, when lack of defiladed approaches forces the squad to take advantage of all available cover, or when the character of the terrain (thick woods, trenches) makes it impossible to use wheel transportation.

The 37m/m gun is easily supplied with ammunition during combat. A total of 224 rounds is carried on the ammunition cart, an amount which will usually be sufficient for one day's fighting. When the piece is carried by hand, the gun section carry with them 64 rounds, enough for several firing positions.

It is a weapon of opportunity, and when not actively engaged should be kept under cover. If the location of a suitable target, such as a tank or machine gun endangering the friendly rifle units, is known, the gun takes up a firing position and goes into action rapidly. It continues its fire until the menace has been destroyed or rendered ineffective; then, before it in turn is recognized and destroyed, it is withdrawn to shelter to await another favorable opportunity.

64. The 3-inch Mortar.—The howitzer platoon has a 3-inch mortar, a high-angle-fire, muzzle-loading weapon whose barrel resembles a section of pipe. Like the 37m/m gun, the mortar accompanies troops on the march and in the attack and defense. The various parts, the barrel, the mount, and the base plate are assembled only when the mortar is to go into action; for purposes of transport, these parts as well as the ammunition are carried on individual hand drawn carts or are moved by hand.

The mortar and its ammunition are heavy. The barrel, mount, and base plate weigh 112 pounds; 1 round weighs about 12 pounds. Consequently, hand transportation is used only when hostile fire or unfavorable terrain prevents the use of the carts. By proper reconnaissance, concealed approaches for the carts can usually be found, and therefore carrying by hand is ordinarily necessary only for final, short moves before occupying firing positions. Transported by the carts, the mobility of the mortar is that of the rifle companies on the march except across country. Transported by hand, the mortar can keep up with riflemen only if the progress of the latter is slow. A proper combination of the two methods keeps the weapons in supporting distance of the assault in all phases of combat.

The barrel of the mortar weighs approximately 44 pounds and consists of a steel tube 51 inches long and 3.2 inches in diameter. The mount, which is detachable from the barrel, is a bipod which serves to hold the barrel in its firing position and at the desired elevation; it is equipped with a traversing and elevating mechanism. The force of the recoil of the mortar is great, and to withstand it and keep the barrel in position its base rests on the base plate, and the feet of the mount are firmly planted in the ground with a sandbag placed on each. The base plate is made of pressed steel and is indented in three places to receive the base of the mortar when set at any one of three possible angles. The base plate serves the double purpose of furnishing enlarged surface next to the ground, which takes up the recoil of the mortar and, at the same time, prevents the position of the barrel from being greatly altered when the weapon is fired. By using the three indentations in the base plate, 12° of traverse can be obtained; in addition there is a traversing screw which gives 6° more, so that a total of 18° can be had. This is a small limit of traverse, and the use of the outer indentations throws the force of recoil too near the edge of the base plate for prolonged, accurate shooting. Therefore, as soon as practicable after the occupation of any firing position, a sufficient number of supplementary base plate pits should be dug to enable the mortar to fire in any required direction

The limiting ranges of the mortar are from 250 to 750 yards. It is thus suitable for close support of rifle units; and as it can be laid on targets and fixed in its position, it can be fired at night from positions in which it is set during the daytime. It can take quick advantage of momentary changes in the action, and is even more valuable for this than is artillery. If desired, the mortar can fire from 20 to 30 rounds per minute for a period of from three to four minutes duration; however, because of heating and the collection of gasses which necessitate frequent swabbing of the barrel, the average rate that can be kept up for a long period is six rounds per minute.

In mobile operations, the rate of fire is limited by the ammunition supply; the total amount of ammunition carried for the mortar on the two ammunition carts is 48 rounds. When the carts cannot be used, ammunition, as has been said, must be carried by hand, a method which appreciably limits the usefulness of the mortar, as on account of the weight, four rounds is the limit of the load of each carrier. Of course ammunition is moved by hand only when the mortar is separated from the carts. Great economy of expenditure of ammunition must be practiced, and the system of supply carefully organized.

The shell fired by the 3-inch mortar is of two types, Mk. 1 and Mk.III, depending on the bursting charge. The Mk. 1 is the only shell of high explosive authorized; its casing is loaded with approximately 2.75 pounds of nitro-starch of TNT. The Mk. III shell is purely a practice shell, and its casing, instead of being loaded with a high explosive, is filled with sand. Both shells are fired in the same manner. The propelling charge is made up of two units, the first being known as "cartridge, Mk. I," which in outward appearance resembles the commercial shot gun cartridge. Its charge consists of 120 grains of sporting ballistite powder. The cartridge is inserted into the container in the base of the Mk. 1 or the Mk. III shell, and is fired when the shell, after being loaded into the muzzle, slides down the barrel and strikes the pin in the base of the barrel. The second unit of the propelling charge consists of a varying number of silk rings, containing ballistite powder, which fit around the exterior surface of the cartridge container in such a manner as to cover the openings in it. The purpose of the rings is, by the force of their explosion, to increase the propelling charge and thus obtain greater ranges than are possible with the cartridge alone. The more rings, the more distance, although the use of more than three is prohibited because a greater number will develop such a pressure that the mortar may burst.

The firing of the 3-inch mortar is accomplished in a manner radically different from that employed in discharging any other infantry weapon. This is so because it has no breech mechanism which moves during the operation of firing; the firing mechanism is stationary, and consists of a firing pin or striker rigidly fixed in the base of the barrel. In order to fire, the shell is placed in the muzzle, is released, and slides down the barrel. The primer of the cartridge strikes the nipple of the firing pin, and explodes. This fires the cartridge. The burning gases, passing through the holes in the cartridge container, act against the base of the shell, forcing it out of the mortar. The empty cartridge remains in the cartridge container and is carried from the mortar in the shell. In case powder rings are added, they are ignited by the burning gases from the cartridge, with the result that breech pressure and muzzle velocity are both increased. On its forward end the projectile is furnished with a fuze which, when the shell comes to earth, serves to initiate the explosion of the bursting charge.

The 3-inch mortar, like the hand and rifle grenades, is a high-angle weapon. This characteristic makes it suitable for use against targets located on reverse slopes or behind cover. Also, because of its range and the high arc of its trajectory, it can, in many cases, be used effectively against targets which cannot be reached by any of the other battalion weapons. In addition to this, its high angle of fire enables it to be used from behind the protection of well-concealed positions.

When compared with the 37m/m ammunition, the bursting radius of the 3-inch mortar shell is large; when a shell bursts, some of its fragments may fly as far as 300 or 400 yards wounding or killing anyone with whom they come in contact. However, the effective bursting radius of one shell is considered to be 30 yards; by this is meant that any personnel which happens to be within this distance from a point where the shell strikes, has little chance of escaping serious injury or death.

Unlike the 37m/m gun, the 3-inch mortar is an area weapon for use against indefinitely located targets, such as enemy machine guns or concentration of personnel in wooded or defiladed areas. Light matériel, such as machine guns, when situated within ten yards of a burst, is liable to serious damage, and the accompanying crew is certain to be disabled.

65. New Weapons.—Since the manufacture and issue to the services of the howitzer platoon weapons mentioned in paragraphs 63 and 64, improvements in these types of weapons have been made. A new 37m/m gun has been built which fires a 1.2 pound projectile at an initial velocity of 2,000 feet per second. This increase in muzzle velocity was not produced to increase the gun's present satisfactory range, but to get greater armor piercing effect against hostile tanks. The new shell will pierce one inch of armor plate at 500 yards as against one-half inch at 300 yards for the present weapon.

A new 75m/m breech loading mortar has been developed capable of accurate fire at ranges varying from 400 yards to 1,800 yards. The increase in range from the present 750 yard to 1,800 yards is noteworthy. A new Stokes-Brandt 81m/m mortar has also appeared both here and abroad. This mortar is simple in construction (similar to our present 3-inch) but has a range of about 3,000 yards, and is surprisingly accurate. Its accuracy is induced somewhat by placing fins on the projectile, steadying it in flight.

SECTION VI

EMPLOYMENT OF INFANTRY WEAPONS IN ATTACK

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66. General.—Before the World War the armament of the rifle company consisted of the rifle and bayonet, with pistols for the officers and for certain noncommissioned officers. The war witnessed the introduction of the automatic rifle, the rifle grenade, and the hand grenade, and their addition to the armament of the rifle company. The

rifle with its bayonet, however, is still the infantryman's main reliance. In spite of the addition of numerous auxiliary weapons to infantry units, the rifle is by far the most formidable weapon of the infantry soldier; it is primarily the weapon for frontal fire and for distributed fire. Progress is steadily being made in the development of a new individually served automatic arm, and this latter will probably become more prevalent; but the individual soldier, with his own fire weapon, including his bayonet, will remain the basic element of infantry combat. Our present doctrine as regards the automatic rifle is that it is to be used as a means of increasing the fire power of the rifle squad of which it forms an integral part.

67. Weapons of the Squad.—The weapons with which the squad is armed are all light in weight. Hence, the mobility of this unit is not curtailed; in fact, it is able to maneuver with the approximate ease and mobility of one of its individual riflemen. The flat trajectory weapons of the squad are the rifle and the automatic rifle; its high angle fire weapons are the hand and rifle grenades. Thus, since the rifle and automatic rifle are able to reach enemy personnel encountered in the open, and the grenades are capable of reaching hostile elements operating from the shelter of shell holes or light entrenchments, we see that the squad itself is capable of dealing with all enemy personnel not defended by such devices as protective armor or by entrenchments of a permanent nature.

In general, the fire characteristics of the rifle and automatic rifle are similar. However, the effective rate of fire of the automatic rifle is greatly in excess of that of an individual rifleman; in fact the former weapon is capable of a volume of fire equal to that of a number of riflemen. Also, one man can maneuver more easily and quickly than a group of men. The weight of his weapon being very little greater than that of a rifle, the automatic rifleman has approximately the same mobility as the rifleman. Thus, in his automatic rifleman, the squad leader has at his command the means with which he can, at short notice, bring a concentrated volume of fire on any target. This mobility of fire and movement of the automatic rifleman is invaluable. It enables the squad leader, on short notice, to meet many embarrassing if not fatal situations; often such occasions arise when the squad is engaged in a fire fight and some unlooked for hostile group appears on its flank or rear. There is, however, the question of ammunition supply, since the automatic arm has, of course, a high rate of consumption.

With its hand and rifle grenades, the squad is provided with high-angle-fire weapons with which to combat hostile dispositions whose location in shell holes or dugouts is such that it may not be feasable to overcome them by use of the flat trajectory weapons or with the bayonet. In using grenades offensively, cover for the firer is the first essential. Especially is this true for the hand grenade. The radius of action of this weapon is to all intents and purposes almost as great as the distance that the average grenade thrower can hurl it. Thus, it happens that in many attacks over open terrain, it will be impossible to use the hand grenade except where convenient shell holes or other similar depressions lend shelter to the advancing grenadier.

While there is no described division of the rifle squad into subordinate units, it must be understood that this places no bar upon the squad leader as to the employment of any portion of his squad for fire

and maneuver in accordance with the dictates of any particular situation. The very armament of the rifle squad, including as it does rifle and bayonet, automatic rifle, and the hand and rifle grenades, of itself contemplates or suggest the employment of part of the unit to pin down or fix the enemy, while the remainder maneuvers to the flank or rear of the hostile resistance. Thus, when confronted with a hostile machine gun, automatic rifle, or sniper post, part of the squad, such as certain riflemen, the automatic rifleman, and the rifle grenadier, may continue pressure against the enemy front, while the remainder, armed with hand grenades and with bayonets fixed, maneuver to the flank or rear of the hostile point; at the decisive moment one or both elements then rush into assault.

In conclusion, a word about the bayonet. In order to be a really good infantryman the man must be thoroughly imbued with the will to use the bayonet. This spirit is the final requisite which, combined with a confidence in the rifle and the ability to shoot, fosters the grim determination of the firing line to close with and destroy the enemy. It is the overwhelming impluse behind every successful bayonet assault.

The fighting instinct of the individual man must be developed to its highest point. It first appears in a recruit when he begins to handle the bayonet with facility, and increases as his confidence grows. With the mastering of this weapon there comes to him a sense of personal fighting superiority in physical conflict. He knows that he can fight and win. His practice becomes snappy and full of strength. Such a man will fight as he has trained, spiritedly and effectively. While waiting for the zero hour he will not fidget nervously. He will go over the top and win.

Successful training implies that men will use on the battlefield what they learn on the drill ground. To do this, a man must move to the attack possessed not only of a determination to win, but also of a perfect confidence in his primary arm, the rifle. Without this, a bayonet assault will fail. The man who bores in at a dead run enjoys the advantage of a superior morale The man who waits to fence loses his nerve and lets the enemy take heart. If the opponent has the longer weapon, the man gains an advantage by closing with him instead of standing off and fencing.

The bayonet is the ultimate factor in every assault, and the man must realize that its successful employment requires of him not only individual physical courage, but also perfect discipline and a thorough knowledge of teamwork. In a bayonet fight, the nerviest, best disciplined, and most skilful man wins; the will to use the bayonet and thorough training assure success. The perfect confidence of the man in his weapon is born only of thorough, constant practice, which is the very essence of bayonet training.

To be successful it is vital that each bayonet fighter be thoroughly trained to think and act for himself, and that there be no interval of time between thinking and acting. To attack effectively with the bayonet requires nerve, good direction, strength, and quickness during a state of extreme excitement and probable physical exhaustion. To be in a high state of physical developemnt is a requisite for the bayonet fighter, in order that he be reasonably certain of successfully driving home his attack.

It must always be remembered that the bayonet is essentially an offensive weapon. One should rush straight at an opponent with the

point threatening his throat, and deliver the thrust wherever an opening presents itself. If no opening is obvious, one must be made by deflecting the opponent's piece or by threatening him on one side and driving in on the other. But keep boring in. The man who fails to get his thrust home when an opening presents itself for even one fifth of a second may lose his life. In a bayonet assault, all must go forward with a determination to win.

While actual bayonet combat is individual, each man must understand from the very first that he is fighting for his side and not for himself alone. If follows, therefore, that he must be familiar with the tactical employment of the bayonet. He must know not only how, but when, and when not to use it. For instance, it is absurd for a bayonet man to pursue a retreating enemy and stab him in the back; he has a bullet in his rifle for just that situation. Again, the man who, forgetting that he is only a member of the team, rushes far ahead of his comrades, is always needlessly killed, thus helping the enemy and wasting his own life. Perfect teamwork is required in the bayonet attack.

In both stabilized and mobile situations the bayonet man is frequently called upon to act as a protector to his constant comrade, the grenade thrower. This requires that the bayonet man be familiar with the tactics of both the bayonet and the grenade in mopping up parties, raids in either stabilized or mobile situations, in advancing through shell holes, and in assault waves.

68. Machine Guns.—For the infantry, machine guns are an important source of fire power; the possibility of developing a tremendous amount of fire, when considered in connection with the mobility of machine-gun units, constitutes them one of the most effective means of supporting an attack. Moreover, the quality of the machine gun support may be a highly important factor in the success or failure of the plan of action.

The plan of action of the commander should contemplate the full utilization of the fire power of all machine guns, both of battalions in assault and, when practicable, of those in reserve. The machine-gun and howitzer company is an integral part of the infantry battalion, and when the battalion becomes an assault unit its machine-gun and howitzer company always operates with it. Higher commanders should avoid issuing orders which would effect the activities of such companies except to make known the targets to be engaged by other machine-gun units and the location of these latter elements.

The commander of an assault battalion is responsible for the proper tactical use of his machine-gun and howitzer company. All machine guns, when practicable, should be used to support the assault rifle units in the initial stages of the attack; thereafter their forward movement should be so regulated as to furnish the maximum supporting fire to assault units, consistent with safety for the flanks of the battalion. In general, the machine guns should be so employed as to further the scheme of maneuver of the battalion.

69. Localities of Employment.—Elevated localities, as close in rear of the line of departure as safety will permit, are utilized for initial machine-gun positions. This avoids the necessity for forward displacement in the early stages of the attack, and facilitates overhead fire.

Effective machine-gun support after the attack is launched is dependent upon pushing part of the guns well forward, close in rear of the assault rifle elements. This prompt forward movement often affords

the opportunity for flanking fire even though there be no available elevated positions. Machine gun positions should not interfere with the maneuver of rifle units.

70. Antiaircraft Protection.—In the attack it is not practicable for a machine-gun unit, as a whole, to be prepared to execute simultaneously a ground fire mission and an antiaircraft fire mission of equal importance. If the fire power of all the machine-gun units of assault battalions be considered essential to the successful advance of assault rifle companies then the machine-gun antiaircraft fire, when necessary, should be provided form units of reserve battalions.

71. Forward Movement of Guns.—During the action, not all machine guns are moved forward at once. When the company is employed as a unit, it usually advances one platoon at a time; likewise the platoon, when supporting a rifle unit, will send forward one section at a time. This is called the "leapfrog method." After the attack is launched, the leapfrog method of forward movement results in a formation in depth which affords additional protection to the flanks of the attack, while not sacrificing a flexible covering fire for the units moving forward. Indeed by virtue of this system, the battalion commander has some machine guns always on hand for the close and effective support of the assault line. This he accomplishes by insuring prompt forward movement, keeping the guns close in the rear of the advancing rifle units.

72. Flanking Fire.—Localities captured from the enemy frequently afford positions from which machine guns will be able to engage from the flank other points which are still resisting, thus enfilading organized tactical localities that prevent the advance of our own adjacent assault units. In such situations machine-gun fire is especially valuable, and a portion of the guns should be advanced promptly. Movement into localities permitting such fire should be effected as soon as the friendly rifle units have captured them and evidenced ability to hold them.

73. Consolidation of Captured Positions.—When the objectives assigned to assault battalions have been gained (or reorganization has been ordered), a sufficient number of machine guns should at once be moved forward by the commander immediately concerned, in order to cover effective y the front and flanks of the pos tion to be organized for defense, or to cover the reorganization.

74. Machine-gun and Howitzer Companies of Reserve Battalions.—While the machine-gun and howitzer companies of reserve battalions should habitually be tactically available to proper battalion commanders, they should nevertheless be utilized as main supporting fire groups to assist in the attack whenever the tactical situation permits. Such machine-gun and howitzer companies may be moved sufficiently far forward from the location of the reserve units to permit them to support an attack effectively, provided that the place of employment is on or near the future route of advance of the battalions concerned. This use of the machine-gun and howitzer company should not so weaken its personnel or deplete its equipment or ammunition as to interfere with the effectiveness of its own battalion in later stages of the action. The mission of such machine-gun and howitzer units will usually be to support the attack in its initial stages. To accomplish this, machine-gun fire either by direct or indirect laying may be employed (direct laying should be used whenever the situation permits), and it may be delivered not only against the enemy immediately in front of

assault units but also against the supports, reserves, and aircraft. The execution of the mission should usually be limited to fire from designated positions; movement forward will be exceptional until after the companies have reverted to the control of their proper battalion commanders.

When the tactical situation demands it, certain machine-gun units should be so placed as to cover the approach of battalions to their assembly positions or even to the line of departure. Such use is particularly applicable against enemy aircraft.

75. Use of Carts.—Carts should be used whenever, and as long as, practicable. This applies not only to transporting the guns and ammunition as near to the initial firing positions as safety from enemy observation will permit, but also to the subsequent forward movement. When carts are used to transport the equipment, the mobility of machine-gun units is almost equal to that of rifle units.

76. Howitzer Platoon Weapons.—In general, the missions of the 37m/m gun and the mortar are the same; the methods in which the mission is executed, however, and the powers and limitations of the two weapons are different. In the initial stages of an attack all available howitzer platoon weapons should be utilized to support the attacking units. These weapons are very effective against hostile machine guns and tanks. Appropriate targets are those threatening the units making the main effort. Ordinarily, on account of the short range and the need for good observation, firing positions should be well forward. To avoid interference with assault rifle units and in order not to attract additional enemy fire on these elements, the positions selected for howitzer platoon weapons are usually from 200 to 400 yards in rear of the line of departure.

Weapons of the howitzer platoon are not suited for barrage missions in offensive operations on account of their limited range, the ease of detection by the enemy, and the difficulty of ammunition supply. They are weapons of opportunity and may be considered as most effectively fulfilling their intended role when, by their mobility and proximity to unforeseen targets, they can effectively reduce such hostile resistance and promote the advance of assault units. The zone of action of the howitzer platoon is usually that of the battalion but it may also include targets outside this zone when those targets are menacing the battalion or are holding up the attack as a whole.

77. Mission of the Howitzer Platoon.—The general mission of the howitzer platoon is to render close and effective support to its attacking rifle companies. The platoon may be employed to deliver preparatory fires, but such use precludes the surprise effect of the weapons and may also result in their destruction before the attack is launched. The mission given the howitzer platoon should be such as best to assist the main effort of the battalion. Such an assignment will promote the scheme of maneuver of the assault battalion commander, and will serve as a guide to the leader of the howitzer platoon in the later stages of the action. The fire of the platoon should be utilized to further the advance of assault rifle units. The platoon usually moves forward by bounds from firing position to firing position, both weapons for the sake of control moving at the same time. It would be a very exceptional case in open warfare for the battalion commander to order his supporting weapons to remain in their initial firing positions until ordered forward. Such a provision restricts in a large measure the close and effective support which would result from the advance of the supporting howitzer

platoon weapons at the earliest practicable moment in any given tactical situation.

SECTION VII

EMPLOYMENT OF INFANTRY WEAPONS IN DEFENSE

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78. Rifle and Bayonet.—A successful defense depends primarily on the effective combination of the fires of the various weapons at the disposal of the defender. Other things being equal, the rifle is more effective here than in the attack, because of the protection afforded by field fortifications, because of the greater stability in aiming, and better knowledge of the range. The rifle, as has already been noted, is primarily the infantry weapon for frontal fire and for use against targets distributed in width. It is most effective against personnel, and can seldom be used to advantage against matériel. In the hands of a well-trained man, and at short ranges, the rifle has a rate of 10 to 15 well-aimed shots per minute. Depending on the size of the visible target and the skill of the riflemen, its fire is effective against individual targets at maximum ranges of from 600 to 1,000 yards. The bayonet, of course, is equally useful for close-in-fighting, whether in offense or defense.

79. Automatic Rifle.—As we know, the automatic rifle is not habitually fired automatically. When fired at the same rate as the rifle, its effectiveness is the same; however, the fact that it can be effectively fired at from 40 to 60 shots per minute, and its superior fire control, makes it equal to several rifles. In the defense it is used to cover dead spaces in the bands of flanking fire laid down by machine guns, to cover intervals between organized tactical localities, to deliver flanking fire in front of its own or adjacent combat posts and frontal fire against an enemy advancing toward it. Generally, it will be restricted to definite lines of fire, but will execute those missions which provide the best coördination with the fires of other weapons.

80. Grenades.—Grenades are high-angle-fire weapons especial adapted for use in close combat against an enemy that cannot be reached directly with other means. In addition to being employed as high explosive projectiles, they may be used in favorable situations, as vehicles for smoke, gases, or other chemicals. Hand and rifle grenades, being high-angle-fire weapons, are especially adapted for use in close combat against an enemy that cannot be reached directly by other weapons.

81. Machine Guns.—*a.* The number of machine guns assigned to a given sector of a defensive front will depend on the disposition of the rifle units occupying it. For defense of a battle position, sufficient machine guns should be available for the following:

(1) The development of continuous interlocking bands of flanking fire in front of the main line of resistance and such of the other lines of the position as may be necessary.

(2) The distribution of guns in depth sufficiently to cover the

rear and flanks of, and the intervals between, the organized tactical localities on the successive lines of the position.

(3) The delivering of defensive fires out in advance of the battle position, and the support of those elements of the defense located in front of the battle position.

b. Machine guns employed in the defense of a battle position are assigned missions which may be one or a combination of the following:

(1) To cover a given sector of fire by employing direct laying on any suitable target which may appear in it.

(2) To protect by flanking fire a given tactical locality against assault.

(3) To support counter-attacks.

(4) To deliver fire by indirect laying on designated areas.

(5) To deliver antiaircraft fire.

c. In any defensive arrangement, lines are decided upon beforehand, along which, in order to stop assaults, it is desired to place one or more flanking bands of fire. These are known as the "final protective lines." Individual machine guns are sited so that on call, and if the assault is imminent, they (the guns) are switched from targets farther away and fire along this final protective line. In front of a line of resistance, the fire of such machine guns is linked up with that of other weapons to form a continous belt of flanking fire. Dead spaces in this belt are covered by automatic rifle, 3-inch mortars, artillery, and rifle grenades.

d. Machine guns which, because of intervening objects, are unable to fire by direct laying at the beginning of an attack, are given missions of delivering fire on call by laying on approaches or important areas. This mission is first in order of occurrence but second in order of importance to that of delivering fire by direct laying. If forward guns are given indirect laying missions on enemy approaches, such tasks usually will be executed from alternate positions, in order not to disclose prematurely the positions for direct laying missions. The area covered by a single gun using indirect laying varies with the range. The average may be taken as 25 yards wide by 100 yards deep.

e. A plan for the location and employment of machine guns in defense of a given sector is governed by the following considerations:

(1) Guns located near the main line of resistance must be sited, if possible, so as to link their final protective lines into a continuous band of flanking fire in front of the line of resistance. Guns located in the vicinity of the battalion and regimental reserve lines are sited to cover the flanks of, and intervals between, the organized tactical localities in their front, and to place bands of fire in front of the lines on which located. The sectors of fire of guns on the main line of resistance should normally not exceed 45 degrees. The sectors of fire of those guns on the battlaion and regimental reserve lines will usually be somewhat greater.

(2) When a machine gun is firing over level or uniformly sloping ground at a range of 700 yards, the lowest part of the cone of fire in not above the head of a man standing.

(3) For firing over friendly troops, machine guns must be located within about 1,800 yards of such troops. This limiting distance will, in in general permit guns placed on or in the vicinity of the regimental reserve line to participate in barrages in front of the main line of resistance.

(4) Where practicable, in order to insure tactical control of a machine gun section, the guns should be located in pairs with from 20 to 50 yards between pieces. This does not require that they have the same mission, though this is preferable. However, the terrain being

organized for defense frequently is such as to prohibit the location of two guns so close together without impairment of the missions of one or both of them.

(5) Machine guns should be carefully concealed, and every possible means taken to avoid disclosing their locations, thus preventing their destruction by hostile fire. With the same end in view, guns required for flanking the main line of resistance should be located as far to the rear of that line as is consistent with the efficient execution of this mission. Locations near trenches exposed to hostile aërial or ground observation should avoided, if practicable, in order to escape the effect of hostile artillery fire directed on the latter.

(6) The most effective use for machine guns is for flanking or enfilade fire. Flanking fire, combined with surprise action, enables a machine gun to cause tremendous losses in a very short time. To reiterate, also, fire by direct laying is more effective than that by indirect.

82. Howitzer Platoon Weapons.—As has been said, the howitzer platoon is armed with one 37m/m gun and one 3-inch mortar. The platoon is the fire unit except where terrain conditions prevent the location of the weapons close enough together to permit control of both by the platoon commander. However, whenever possible, the two weapons should not be separated more than 200 yards. Positions more than 200 yards apart make control and ammunition supply extremely difficult. The 37m/m gun and mortar are preferably sited to cover the entire battalion sector and any terrain features outside it from which the enemy can bring machine gun fire to bear on the battalion. In those cases where it is impossible to cover the frontage of the entire battalion from a single position, supplementary positions are selected.

The 37m/m gun fires over friendly troops. Hence, it must be located either on commanding ground, or at a sufficient distance in rear to permit of overhead fire. When overhead fire is not feasible, the gun must be located in gaps in the line of riflemen. It usually fires on targets of opportunity; its objective will generally be some such thing as a tank or a definitely located machine-gun nest. The location of the piece is disclosed by its flash, sound of discharge, or the dust raised by the blast; consequently, concealment is of the utmost importance, and alternate positions should be selected beforehand. Locations near important defensive installations should be avoided. And for the above reasons, howitzer platoon weapons should never be placed within strong points.

On the defensive, targets for the 3-inch mortar will be machine guns, accompanying artillery, trench mortars, and similar weapons whose general location is known but which are not definitely located. This weapon will also cover areas that are dead to the fire of the other arms of the defense, and participate in the barrages in front of the line of resistance. The fire in the latter mission must be carefully coördinated with that of the machine guns and supporting artillery.

As the mortar can fire from well-defiladed positions, locations are sought in ravines, or reverse slopes of steep hills, in sunken roads, in woods, or behind buildings. As the projectile in flight is visible to the naked eye, dark backgrounds are desirable to prevent the enemy locating the piece by observation immediately after the mortar has been fired. Discovery of a mortar in action will promptly draw hostile fire, and locations near occupied trenches or defensive installations are therefore to be avoided. Alternate positions should be provided. To maintain a normal rate of fire of six rounds per minute, the mortar must be located within easy carrying distance of a suitable route of communications as the ammuntion is heavy.

SECTION VIII

SOME ARTILLERY WEAPONS, THEIR AMMUNITION AND FIRE EFFECT

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83. The Weapons.—The supporting artillery weapons with which our infantry may most frequently be concerned are the 75 m/m gun and the 75 m/m pack howitzer. A gun has a comparatively flat trajectory and high muzzle velocity. A howitzer, in general, has a shorter tube than a gun of the same caliber, a more curved trajectory, and lower muzzle velocity. It is able therefore to reach targets defiladed behind cover which connot be reached by a gun, and correspondingly, to occupy positions with deep defilade, as behind a ridge, impracticable for a weapon with a flatter trajectory. Because of its shorter tube and the fact that its muzzle velocity permits a lighter construction, a howitzer can be made considerably more mobile than a gun of equal caliber.

84. The 75 m/m Gun.—The 75 m/m gun, M1897, is the service type of the French Army. It was the forerunner of all modern light field artillery and has held its own for more than twenty-five years in spite of the progress in gun design and gun making. It is simple, rugged and efficient. It was adopted by the United States in 1917. Some guns of this model were purchased from the French, while others are of American manufacture, built from French plans. Compared to other similar types, the 75 m/m gun is light, as its weight including gun and limber completely equipped with ammunition and tools is 4,181 pounds.

The extreme range of the 75 m/m gun is 8,800 yards, with a maximum effective range of 7,000 yards where accurate fire is necessary, and a range of 8,500 yards against targets of large dimensions. It fires shrapnel, high explosive, and shells containing smoke and gas. Its rate of fire for prolonged firing is two rounds per minute, while that for short bursts is six. It can go into action in approximately three minutes, and its rate of march over roads varies from three to three and one-half miles per hour.

85. The 75 m/m Pack Howitzer.—The 75 m/m pack howizter made its appearence in the Marine Corps in 1932. It weighs approximately 1,400 pounds and can be drawn by hand on good terrain, packed on mules, drawn by mules or horses, or drawn by tractor. It can be dismantled into loads of 250 pounds or less and debarked from small boats on beaches and set up on shore. Ammunition is either carried on pack mules or in a cart. Its extreme range is 9,200 yards, has an effective range equal to that of the 75 m/m gun, and fires the same general type of ammunition. It takes slightly longer to put the howitzer into action, and because it is not as rugged as the gun cannot sustain fire for so long a period.

86. Ammunition.—The different kinds of ammunition used by 75m/m artillery are the high explosive shell, special smoke and gas, and shrapnel.

High explosive shell consists of a hollow forged or cast steel case filled with a high explosive. Several substances are used as shell fillers or bursting charges; the principal ones in our service are TNT (trinitrotoluene), amatol (a mixture of ammonium nitrate and TNT,) (explosive D) (ammonium picrate), and sodatol (sodium nitrate and TNT). The bursting charge is detonated by the action of the fuze on impact, and bursts the steel case into jagged fragments which are propelled for a short distance in all directions with a high velocity. With shells of light and medium calibers, the effect is produced principally by the fragments of the case. The area effectively covered by the burst of one shell is about 5 yards in depth by 30 in width. Some large fragments may fly as far as 150 yards. The high explosive shell is used for destruction or neutralization of personnel as well as for destruction of matériel, trenches, woods, and other objects, and forms the bulk of the ammunition supply.

Smoke and chemical shell are known as "special shell." The projectile is the same type as in the high explosive shell, except for the filler. Smoke shell contains a smoke producing substance, generally white phosphorus. Gas shell are loaded with chemical agents.

Shrapnel consists of a steel case similar to that of the high explosive shell; this is packed with lead balls of about one-half inch diameter, with the interstices between the balls filled with smoke-producing compound. Below the shrapnel balls at the base of the case is a small quanity of black powder. The fuze is assembled at the nose of the projectile before issue. Prior to loading into the piece, the time train is set so that the fuze will explode just before reaching the target. When this occurs, the flame passes through the central tube, igniting the black powder in the base of the projectile. The explosion of this powder forces the balls out of the case like shot from a shotgun cartridge. They may carry with them the fuze and a part of the ogive (front curve of the projectile). At the same time the matrix is ignited, forming a ball of white smoke, which, as it is visible at long distances, enables the battery commander to adjust the fire for range, height of burst, and deflection. The balls leave the case with an additional velocity of some 200 feet per second, and in the form of a cone; thus, they cover a considerably larger space than that covered by a shell burst. The effectiveness of a shrapnel depends upon the correct adjustment of the height of burst and of the range. As the velocity of the shrapnel balls falls off very rapidly, the balls from a burst too high in air lack sufficient velocity; those from a burst too low cover an area too small to be effective.

Shrapnel is an excellent weapon against personnel in the open. It is comparatively inffective against personnel behind cover or in woods, and it has practically no effect against matériel. The conduct of fire with shrapnel is more difficult than is the case with shell on account of the greater number of elements to be considered. Accordingly, it requires a high degree of training on the part of the battery commander.

87. Effects of Fire.—The effects produced by artillery fire are destruction, neutralization, and moral effect. The first is the most efficacious, but it is possible only against certain fixed objectives or against animate objects in the open. Fire for neutralization is the most usual on the battlefield. Its object is to immobilize the enemy and,

without the expenditure of the time and ammunition necessary for destruction to render his fire ineffective; at the same time it may produce considerable destruction. Even when neutralization is impossible, artillery may still achieve much in lowering the morale of the enemy and raising that of our own troops. Too much fire merely for moral effect is useless, as its value lies entirely in the knowledge by the enemy and our own troops that our artillery fire can, and usually does, produce physical effects.

88. Fire Against Personnel.—Fire against personnel may be delivered regardless of whether cover exists for the enemy. Its purpose is to kill or disable as many of the enemy as possible. When the personnel are sheltered, the object of the fire is usually to keep the hostile troops down in their shelters so as to prevent them from performing the tasks assigned them. Such fire is a form of neutralization. If it is intended also to destroy the works in which men the are sheltered, the fire is primarily for destruction. In conducting fire against personnel, rapidity and density are desirable.

When the personnel fired against is without cover, time shrapnel is highly effective, provided the height of burst can be properly adjusted. High explosive shell is particularly effective when the personnel fired on has some cover. If conditions permit their employment, gas shell of all kinds may be used for this class of fire.

89. Other Fires.—"Harassing fire" is a type delivered for the purpose of annoying the enemy, causing him casualties, and lowering his morale. It is usually directed against camps, billets, shelters, front lines, and assembly places. Either shell or shrapnel may be used; when authorized, and when conditions favor, gas shell may be effective.

"Interdiction fire" is a type delivered for the purpose of preventing the use of certain areas, including roads, by the enemy; such localities may be, for example, probable assembly points where working parties may be attempting to repair destruction already accomplished by our weapons. For interdiction fire, the weapons, the ammunition, and the conduct of fire are, in general, the same as in harassing fire. Where the woods, roads, or other area can be seen, sudden bursts of fire are delivered whenever the enemy appears. At night or when observation is impossible, the fire may be delivered at a slow rate throughout an extended period of time, or it may be delivered in short and rapid bursts of zone fire at irregular intervals and distributed in range; this is necessary in order to make sure that the target is included within the ranges used. In any case it is important to fire in such a way that it will be impossible for the enemy to solve the system and to move his traffic accordingly.

SECTION IX

ARTILLERY IN SUPPORT OF INFANTRY

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90. The Preparation.—The fire of artillery organizations employed to support infantry in an offensive action falls into two general classes; first, that conducted in preparation for the attack, and second, that delivered during the attack. Preparation consists of all fire prior to the advance of the infantry from its line of departure. The time for beginning the artillery preparation is usually prescribed in the order for the attack. Its objects are to paralyze the enemy's system of command, observation, and signal communication, and to neutralize or destroy his artillery and other combat units. Destruction of hostile works, however, except chance destruction during neutralization fire, can be accomplished only by a deliberate fire, with great expenditure of ammunition.

The duration and the intensity of the artillery preparation vary with the desire for surprise, the strength of the enemy's defenses, the ammunition supply, the morale of the troops engaged, the number of tanks employed, and other conditions. In an attack against an elaborately prepared defense, a long preparation, culminating in an intensive bombardment immediately before the advance of the infantry, may be necessary. In other cases, where the enemy's defenses are not extensive or where it is desired to take greater advantage of the element of surprise, the attack may be launched after a short, or indeed without any, artillery preparation. The character of the fire and the objectives attacked vary according to the length of the preparation. In a long continued preparation, many interdiction and other long range fires will be necessary. In a very short preparation, all efforts will be concentrated on points near the enemy's front line.

91. Fire During the Attack.—During the attack, the artillery may provide for "accompanying fire," "concentrations" on critical points, counter-battery, interdiction and neutralization of more distant points and of localities which are not to be attacked directly, and, finally, fire on transient targets. The distinction between preparation fire and fire during the attack is not marked. Actually, much of the artillery may continue on the same missions during the attack as during the preparation phase.

During the attack, the artillery, by accompanying fire (fire which precedes the infantry during an advance and may consist of successive concentrations), by counter-battery fire, and by interdiction fire, assists in overcoming resistance and prevents the enemy from bringing up reserves or from launching a counter-attacck. When detailed plans are prepared in advance, much of the fire is prearranged and delivered in accordance with a schedule. Such a plan, however, must always provide for taking full advantage of all opportunties for observing fire, and for modification of the schedule when actual observation shows it to be desirable.

When the fire is prearranged, a certain number of artillery elements are assigned missions from which they can be withdrawn at any time, without detriment to the general plan, in order to take advantage of opportunities to fire on transient targets (such as batteries changing position or masses of troops in movement), located by aërial or terrestrial observation.

92. Successive Concentrations.—Successive concentrations, as employed in the offensive, are merely concentrations of fire placed successively on certain objectives in advance of, or on the flanks of, the attacking infantry. In the selection of the objectives the interested

infantry and artillery commanders usually confer.

The artillery commander assigns to the units under his command the different objectives which are selected, and thus provides for a series of concentrations which will insure the density of fire necessary for the infantry to take these objectives. The time that each is to begin, and its duration, may be fixed in advance by artillery commanders after consulation with the commanders of the supported infantry, or this may be controlled by signals from the infantry or by direct observation by the artillery of the infantry's progress and needs.

Each battery commander is informed of the different objectives that he will have to deliver fire upon during the advance of our infantry, the location and size of each area to be covered, sometimes the time of beginning and ceasing fire on each area, and, in general, the rate of fire. This information is usually furnished to the battery commander on a chart or an overlay.

93. Defensive Fires.—Artillery fire in support of the defense is very similar to that with the attack. During the period of first contact it consists of fire on transient targets, and of interdicting, harassing, and counter-battery fire delivered upon hostile elements within range. During the hostile preparation for the attack, the defender's artillery fire is delivered with a view to preventing the launching of the attack, and consists of fire on hostile assembly points, routes of approach, and probable positions of reserves, of destruction or neutralization of the enemy's works and of his systems of command, observation, and signal communication, of counter-battery, and of distant interdiction. During the attack proper, the fire consists primarily of fire against advancing infantry, including tanks, of defensive barrages and concentrations, and of accompanying fire for support of counter-attacks. Some of these fires are prearranged, others are not.

Prearranged fires peculiar to the defensive are primarily of two kinds, counter-preparation, both general and local, and standing barrages, including the normal barrage and emergency barrage. In addition to the two kinds of defensive fires just mentioned, fires for defensive concentrations within the friendly lines are prepared when conditions permit.

94. Counter-preparation Fires.—Counter-preparation is designed to break up the enemy's attack before it can be fairly launched. It consists of prepared fire on previously selected localities delivered on the call of a higher commander for a specified length of time. The call is made when it is evident or known that the enemy is about to launch an attack.

The points on which fire is put down are sensitive parts of the enemy's front line trenches or probable line of departure, woods and ravines which afford cover for assembled troops and are likely to be occupied by supports and reserves, important observation points, and other places probably occupied by his formations. Command posts and communication centers are also suitable targets.

The object of a standing barrage is to place a barrier of bursting projectiles between our troops and the enemy for the purpose of stopping his advance. It is a stationary barrage delivered for defensive purposes in front of an occupied line or position.

95. Defensive Barrages.—If, in spite of the counter-preparation, the hostile attack is launched and it progresses toward the line to be defended, a defensive barrage should be put down close in front of that

line for the purpose of stopping the attack. This barrage, known as the "normal barrage," consists of a rapid fire of the light artillery on a single line from 200 to 400 yards in front of the line of resistance. This line may be continuous, if the defender's strength in artillery warrants it; but it is usually broken, covering only those parts of the front where it is believed most likely that the enemy will attempt to advance. The normal barrage is a standing barrage. All batteries concerned, when not otherwise engaged, are kept constantly laid to deliver their part of this barrage. It is fired on any part of the front required, on rocket signal from the infantry, and is the barrage delivered in case of a general attack. The frontage usually assigned a 75m/m gun or howitzer battery in a normal barrage is only about 200 yards. A space much in excess of this makes the barrage so thin as to be ineffective, while a frontage much less causes some of the power of the artillery to be lost.

In addition to the normal barrage each battery usually has one or more emergency barrages for the purpose of reinforcing the normal barrage of another part of the line. Such a fire may be so placed as to fill gaps in the barrage line where the latter is not continuous, or in the case of a continuous barrage line it may be used to increase the density of fire.

96. Defensive Concentrations.—Defensive concentrations are designed to stop and break up the enemy's attack in case it succeeds in making progress within the defender's lines. These are prepared for and delivered on points or areas that are of tactical importance to the enemy, such as likely avenues of approach, ridges or hills, observation points, and wooded or defiladed areas that furnish cover to hostile formations. Defensive concentrations often consist of concentrations of fire in depth placed on the hostile advancing infantry. Zone fire is used. It is directed on the leading elements of the hostile assault waves, and by successive range changes it is made sufficienlty deep to make certain that it includes the hostile local reserves.

Note: The material used in compiling this text was taken from Special Text No. 8, Army Extension Courses, Army Training Regulations, Army Technical Regulations and Volume III, Basic Field Manual.

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